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Brochard et al.

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(54) **LATERAL PROPULSION UNIT FOR AIRCRAFT COMPRISING A TURBINE ENGINE SUPPORT ARCH**

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B64D 27/20	(2006.01)
B64D 27/26	(2006.01)
B64D 29/06	(2006.01)

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CPC ***F01D 25/24*** (2013.01); ***B64D 27/20*** (2013.01); ***B64D 27/26*** (2013.01); ***B64D 29/06*** (2013.01); *Y02T 50/44* (2013.01)

(58) **Field of Classification Search**
USPC 244/54; 248/555, 556, 554, 557; 60/797, 796
See application file for complete search history.

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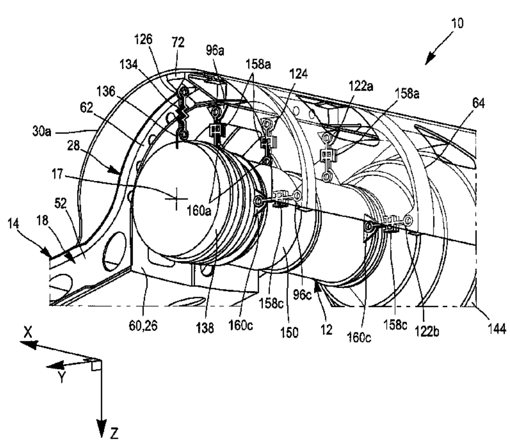
(57) **ABSTRACT**

A propulsion unit for an aircraft, comprising one turbine engine and a mounting device for a turbine engine designed to be added laterally on an aircraft structure and comprising a rigid mounting structure. The rigid mounting structure supports at least one arch which is concave towards the longitudinal axis of the propulsion unit and which has a distal end at an angular distance of between 45 and 120 degrees from a vertical plane passing through the axis, on the other side of the structure, and supporting a distal connecting element connecting the turbine engine to the arch.

13 Claims, 13 Drawing Sheets



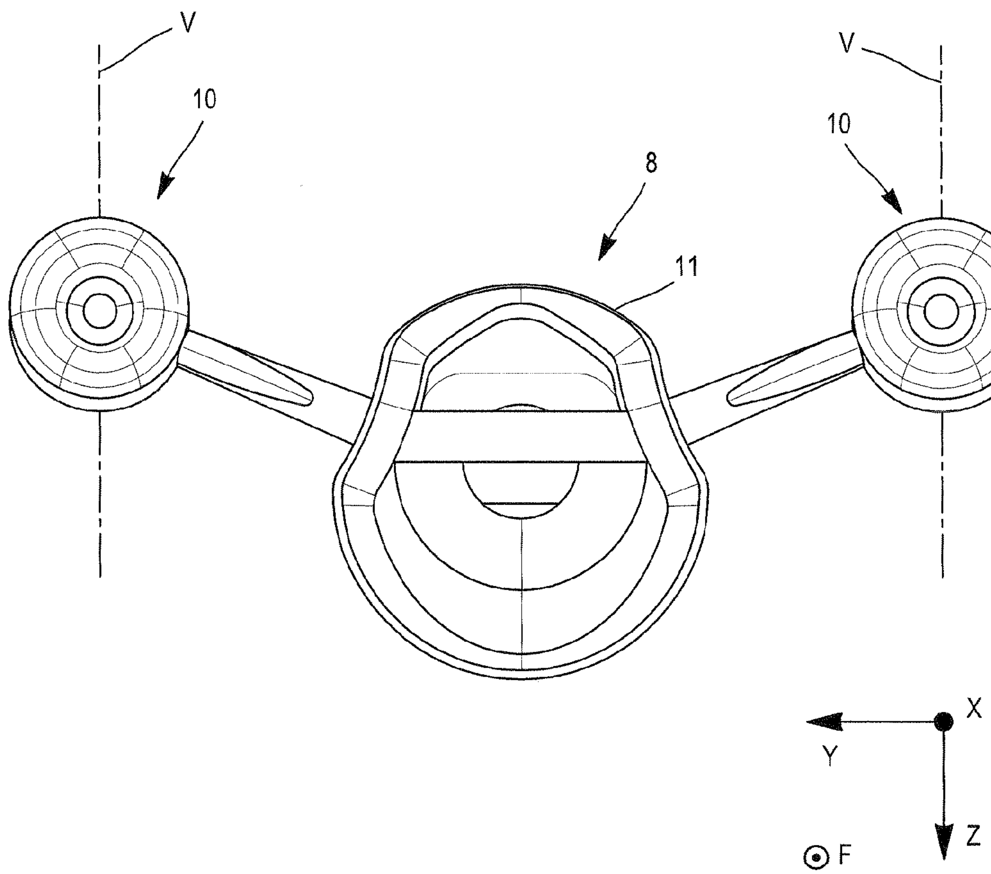
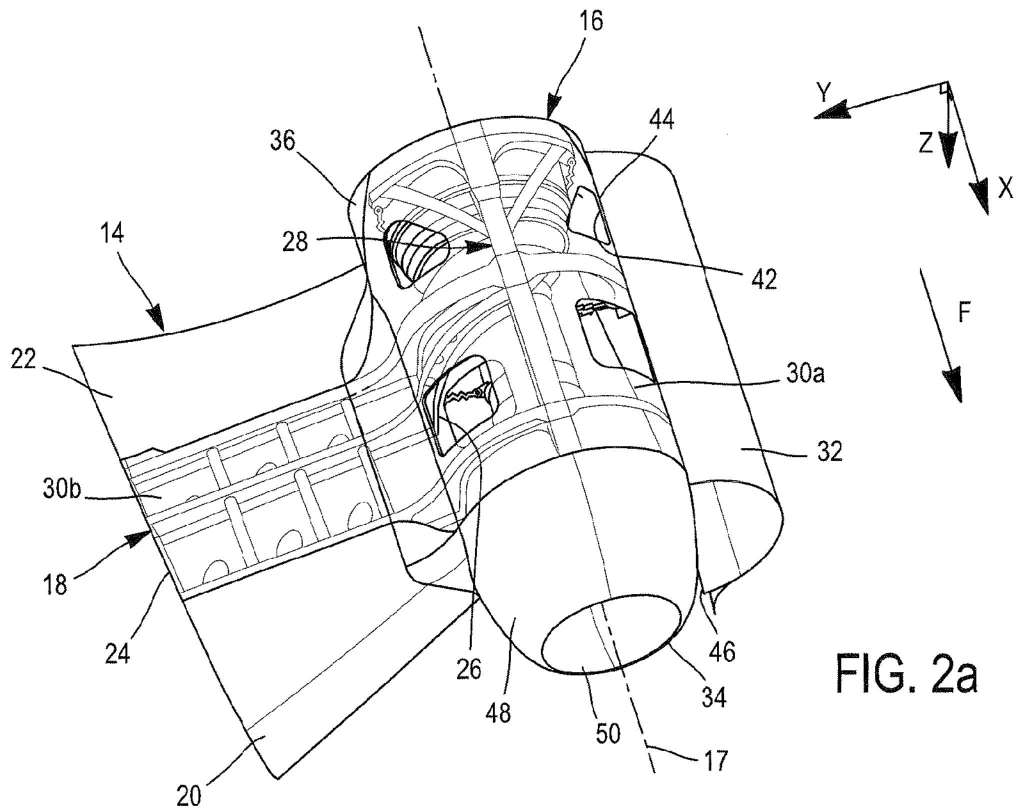


FIG. 1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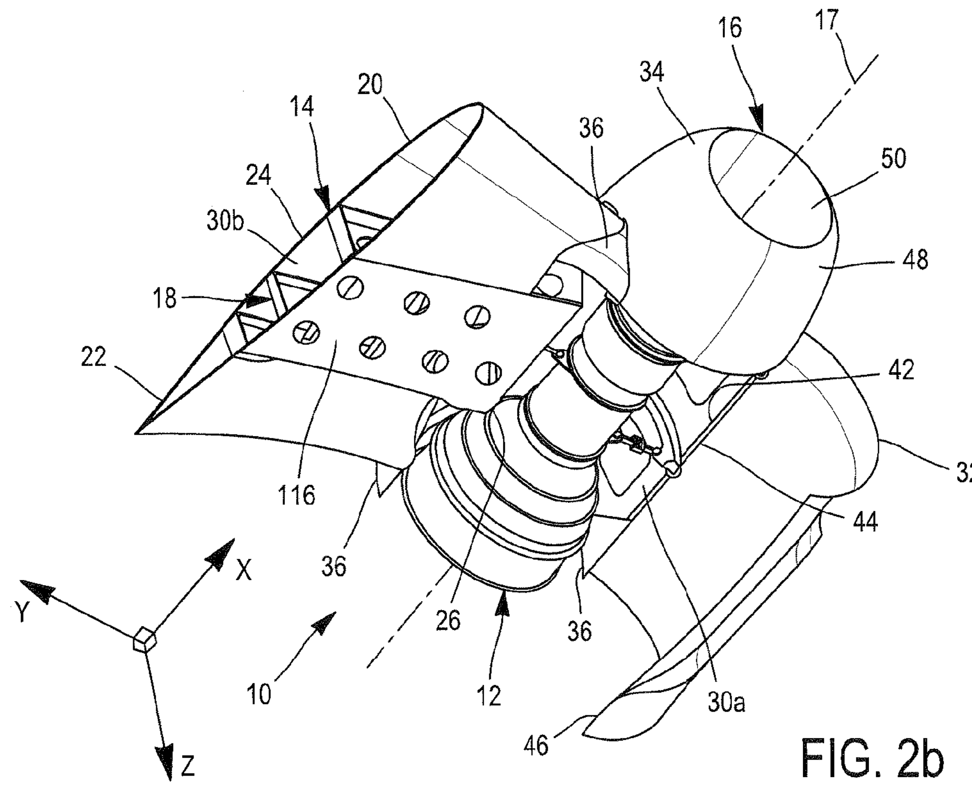
17
20

FIG. 2a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30a
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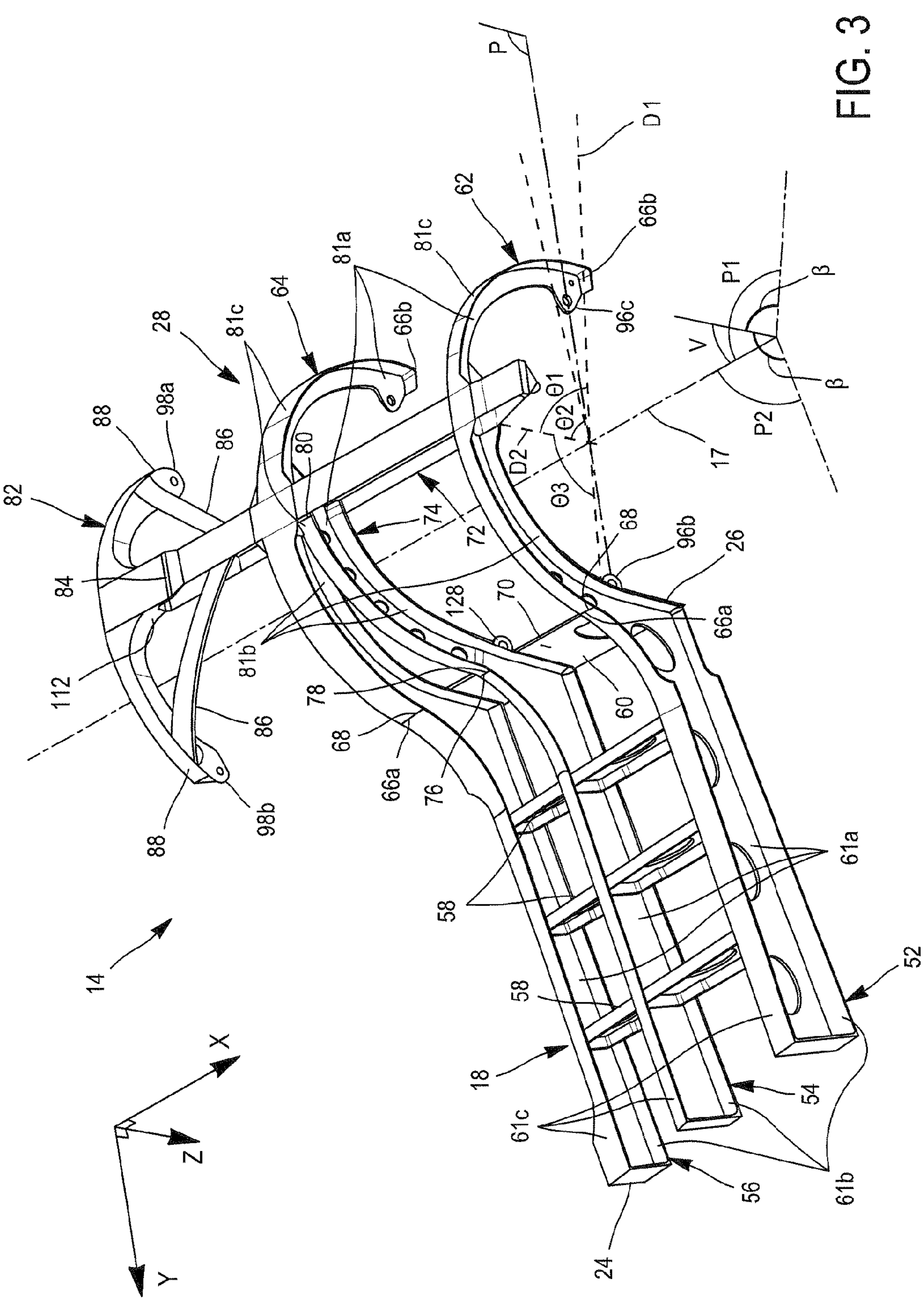
FIG. 2b



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96c
P1
β
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β
P2
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66b
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98a
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82
80
Θ1
Θ2
D2
Θ3
74
72
68
96b
26
84
128
70
66a
112
81b
60
78
86
68
66a
76
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98b
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61a
58
52
14
18
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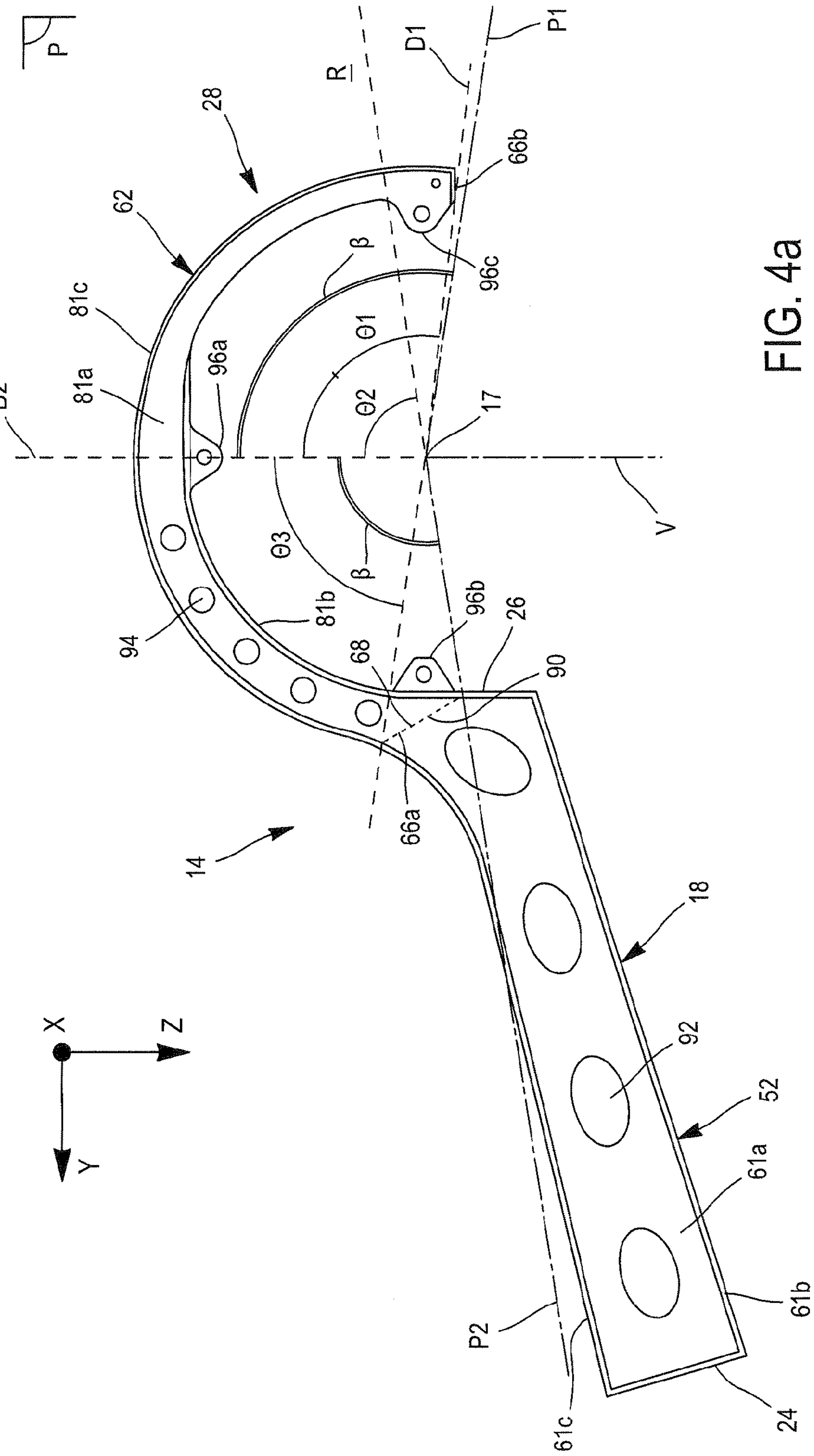
X
61c
56
Z
61b
24
Y

FIG. 3



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Θ1
96a
81a
D2
Θ2
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Θ3
V
β
94
81b
96b
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Y
92
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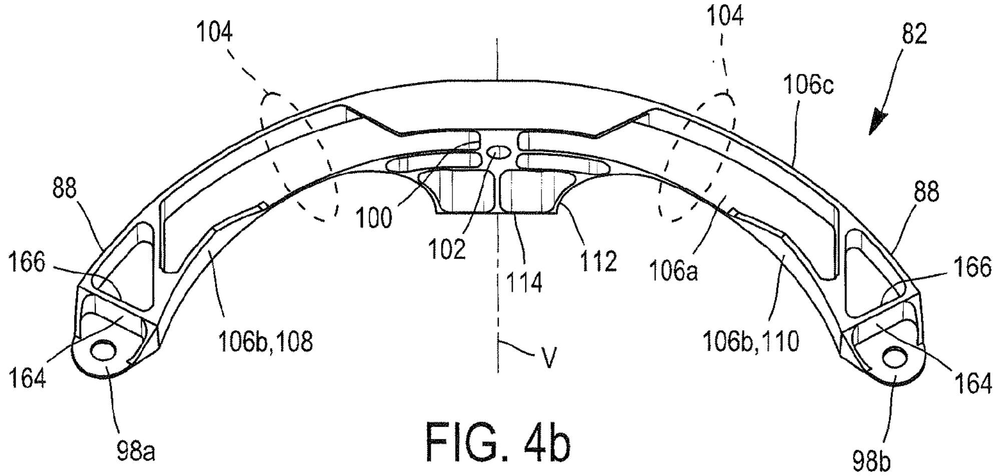
61a
61b
P2
61c
24

FIG. 4a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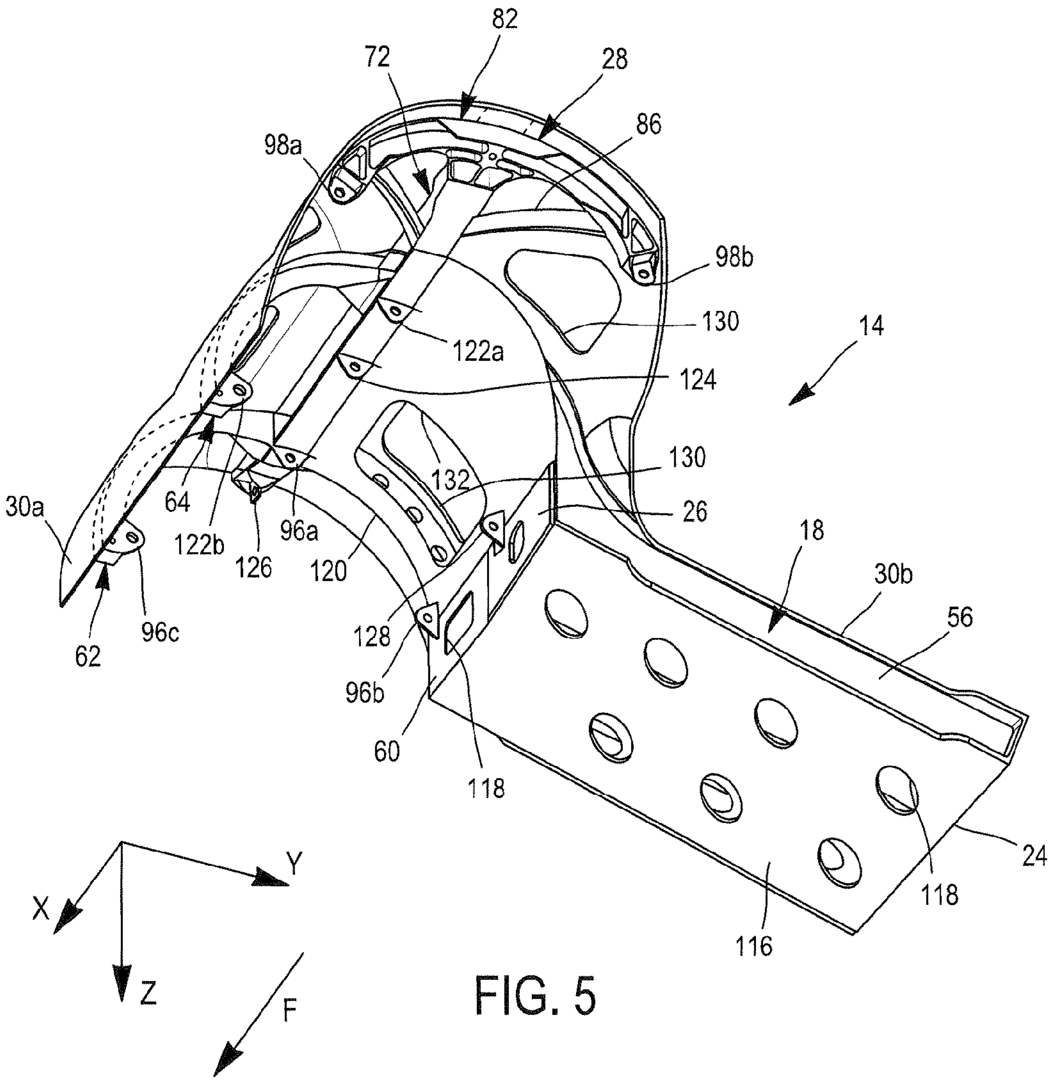
98b

FIG. 4b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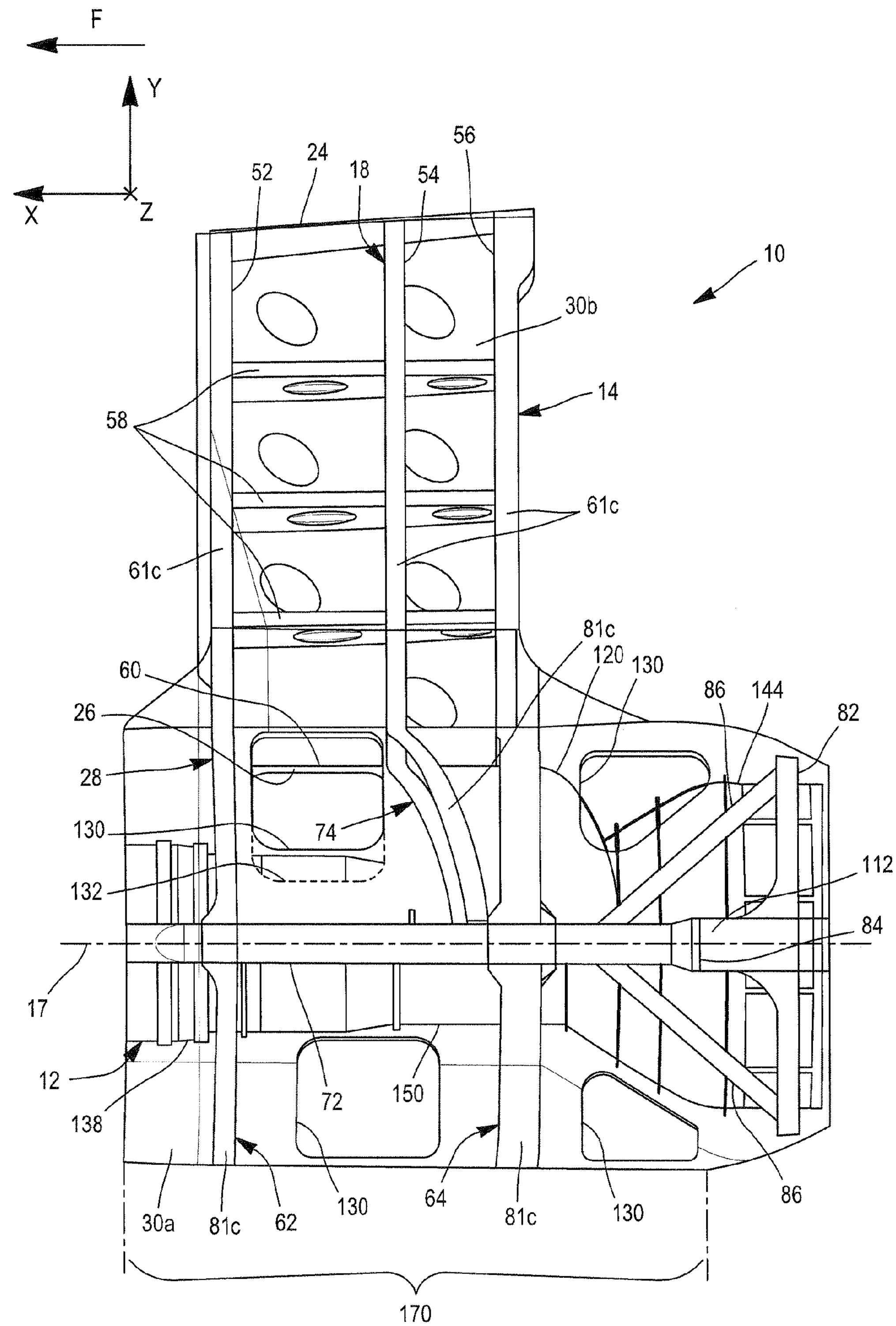
F

FIG. 5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74
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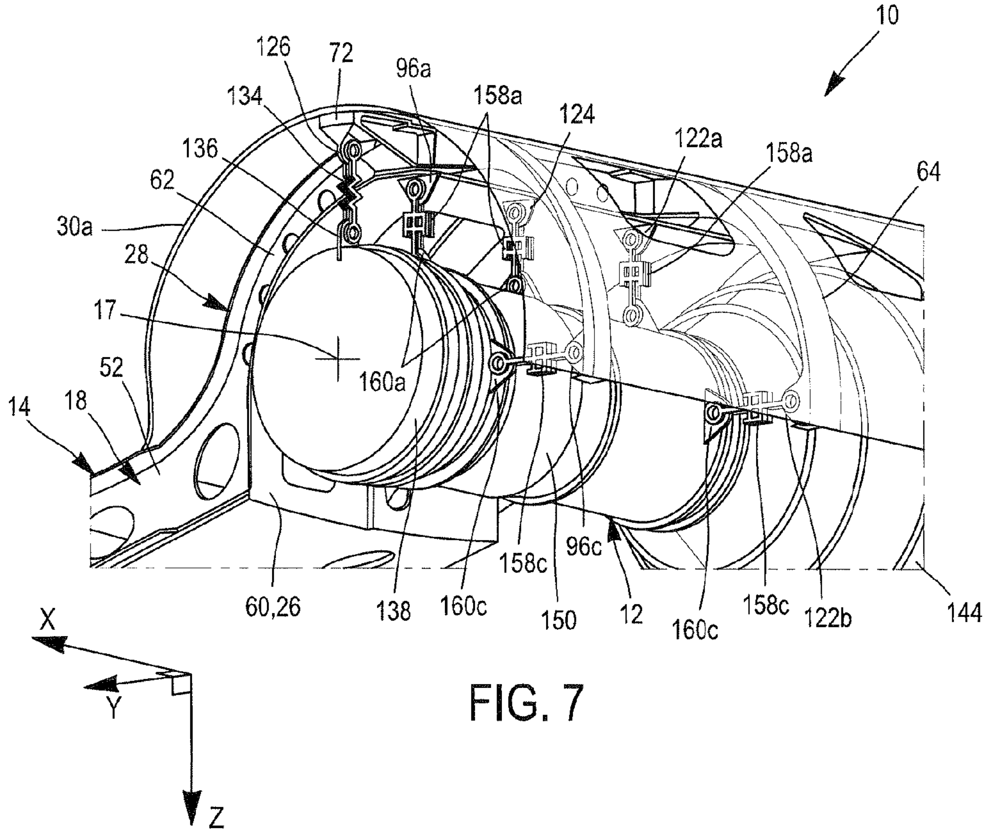
170

FIG. 6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122b
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X
Y
Z

FIG. 7

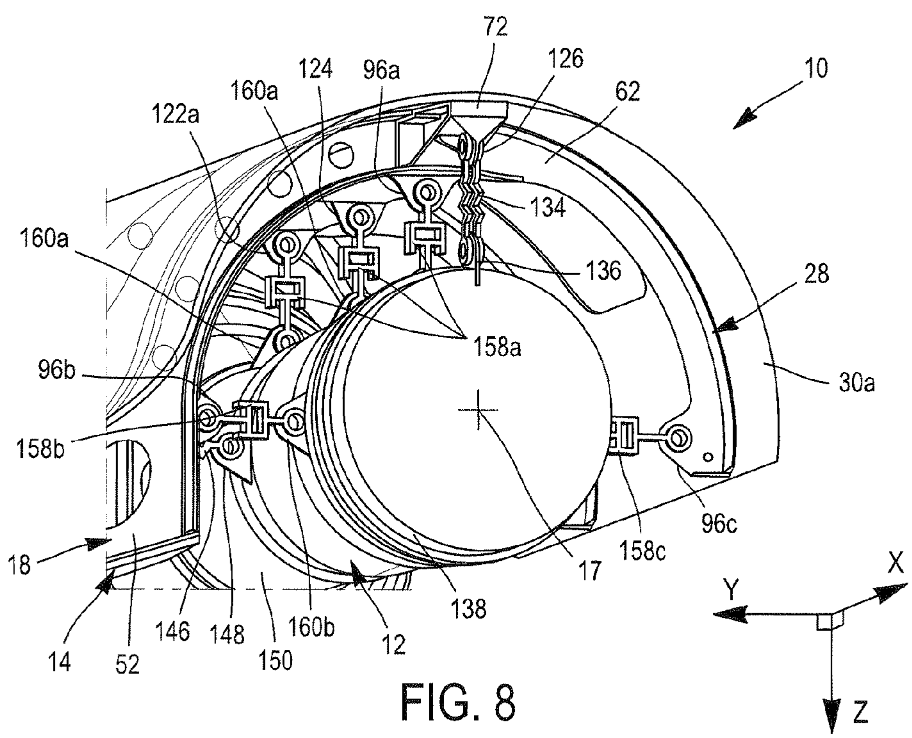
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FIG. 8

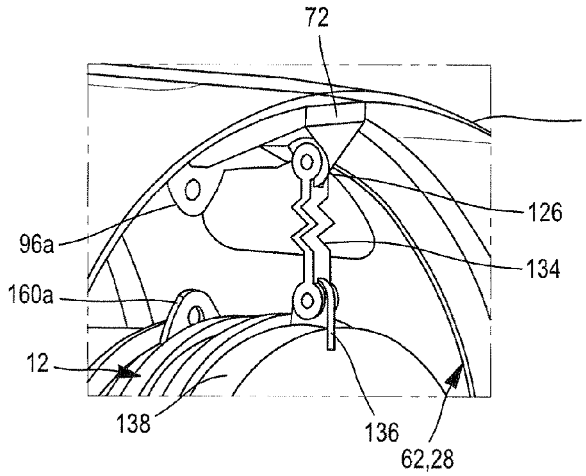

FIG. 9

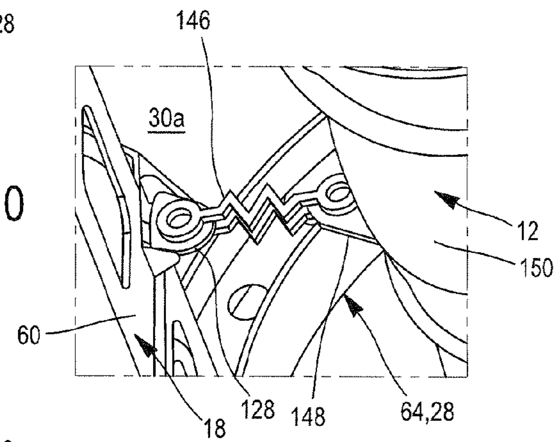

FIG. 10

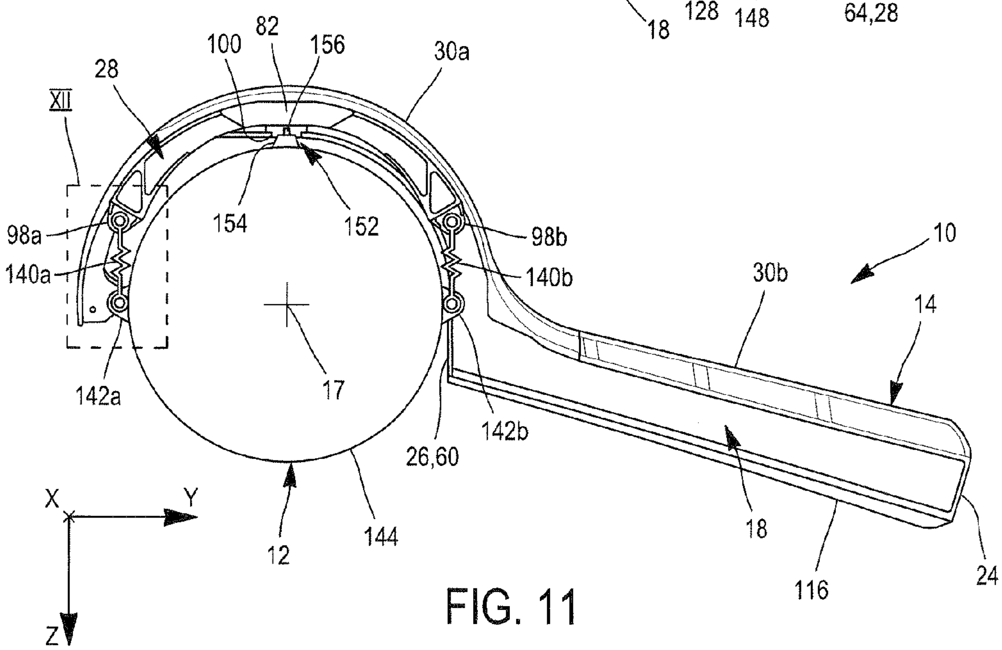

FIG. 11

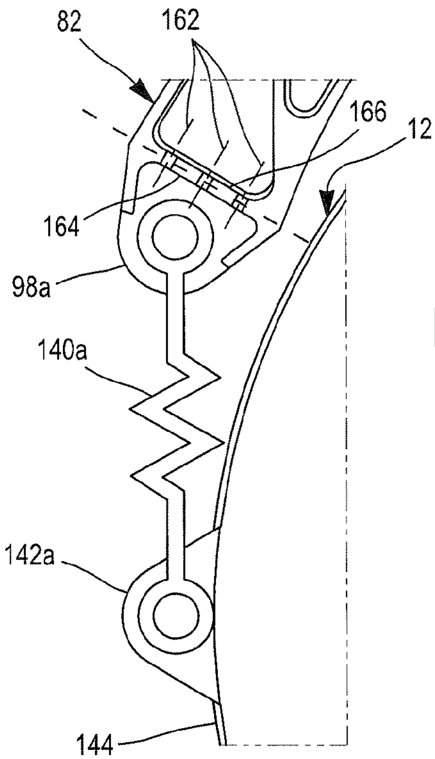
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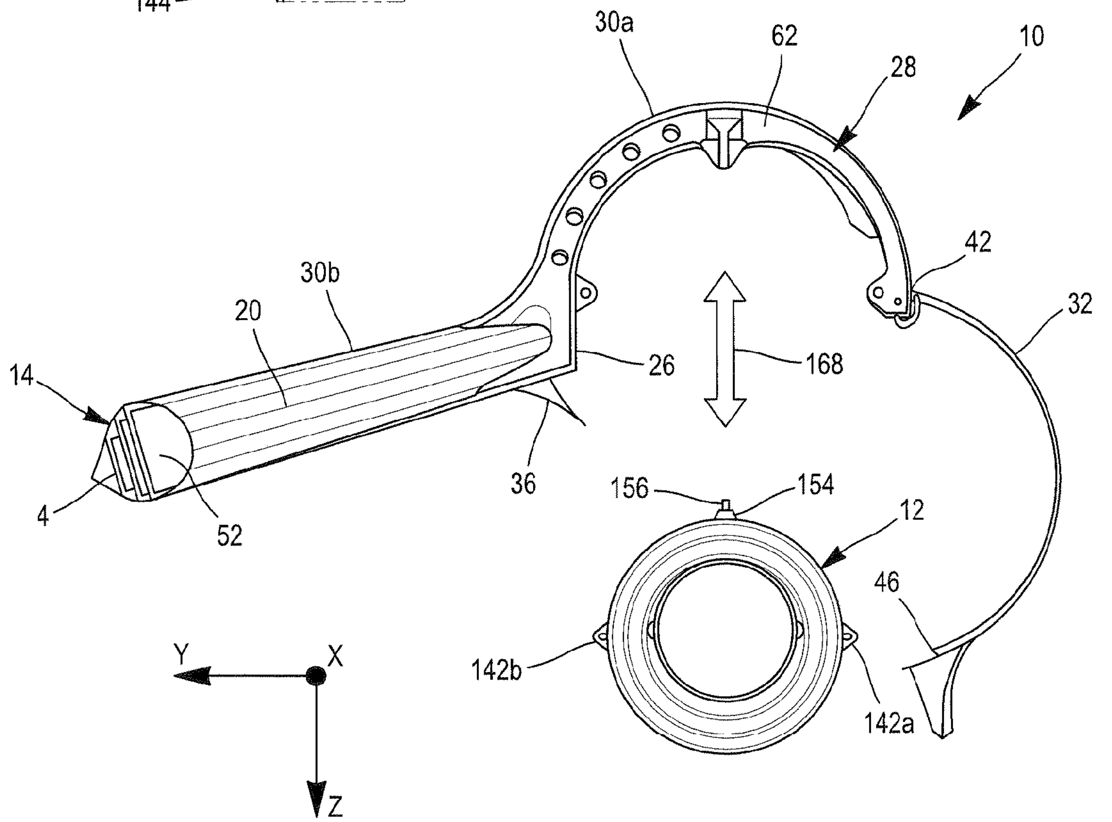
FIG. 12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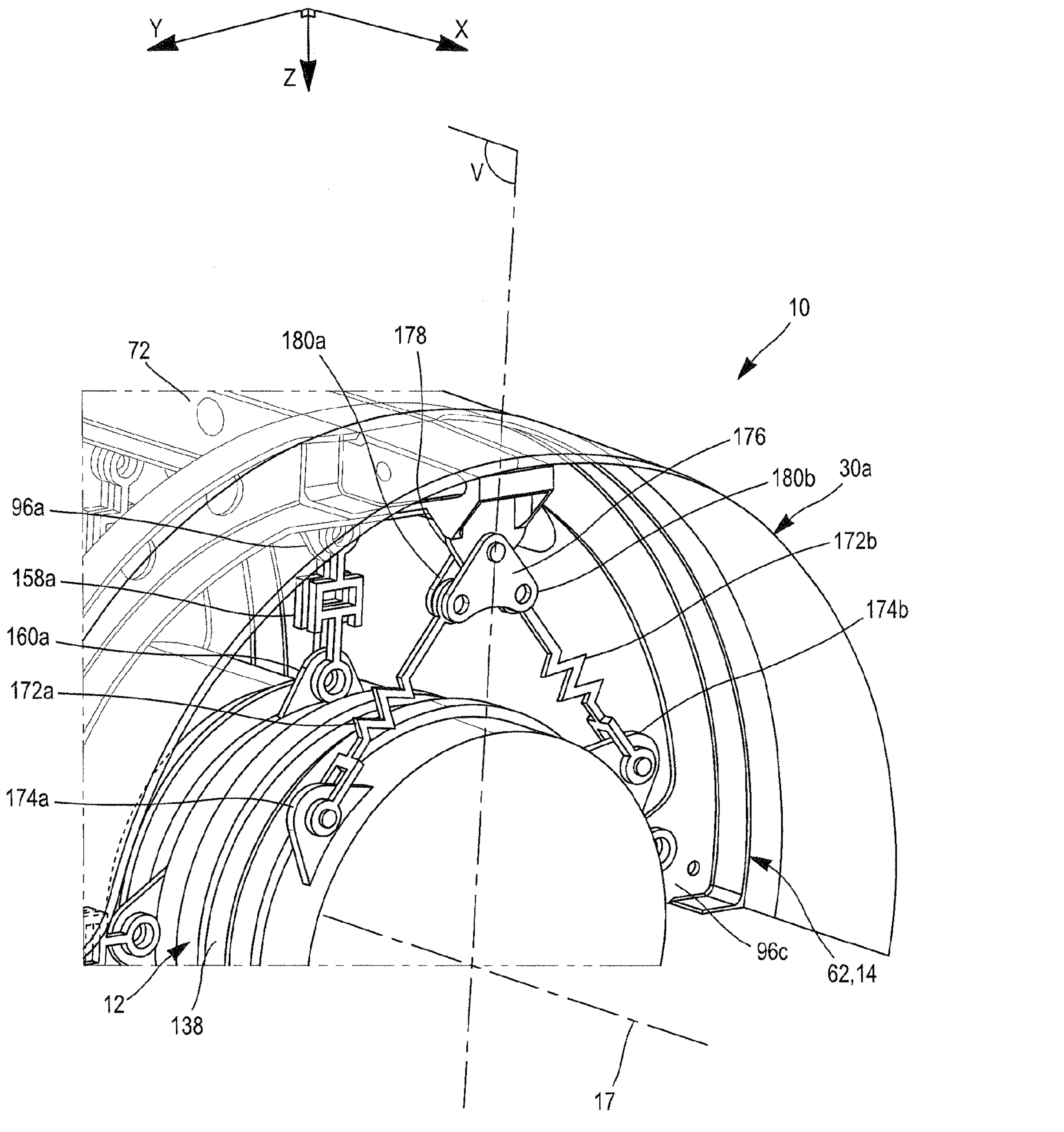
Y
X
Z

FIG. 13



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138
17

FIG. 14

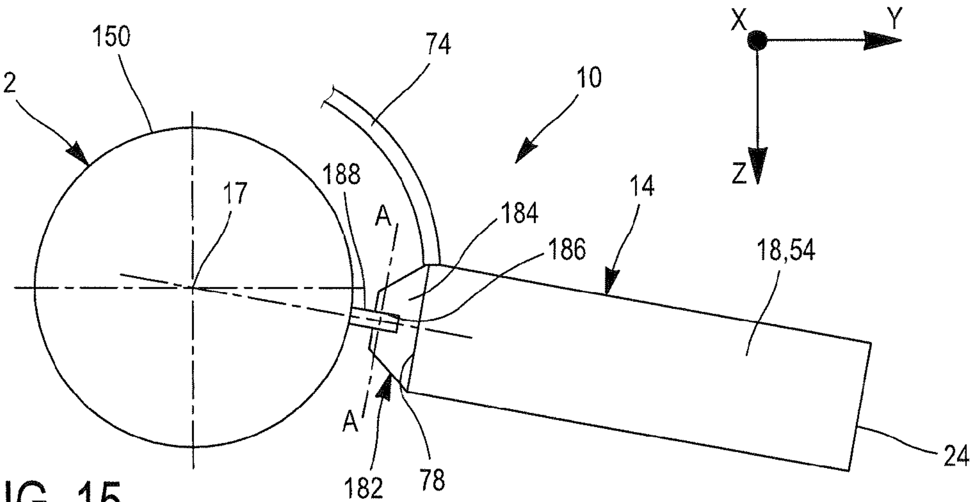

FIG. 15

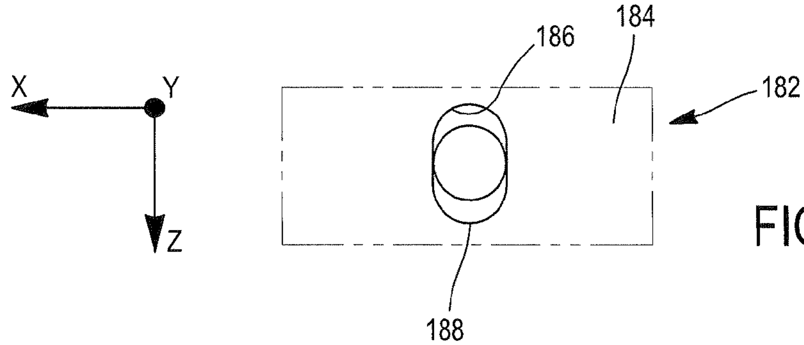

FIG. 15a

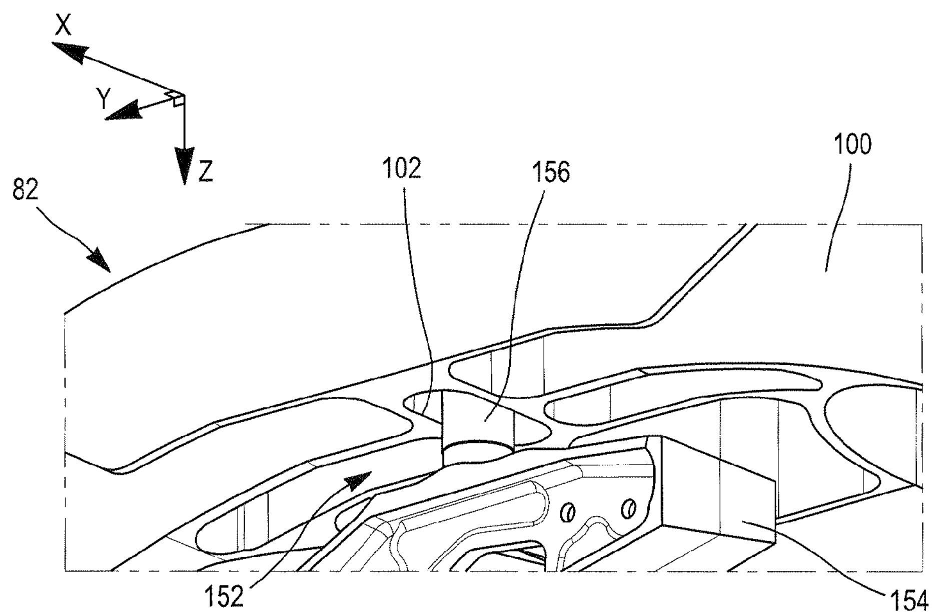

FIG. 16

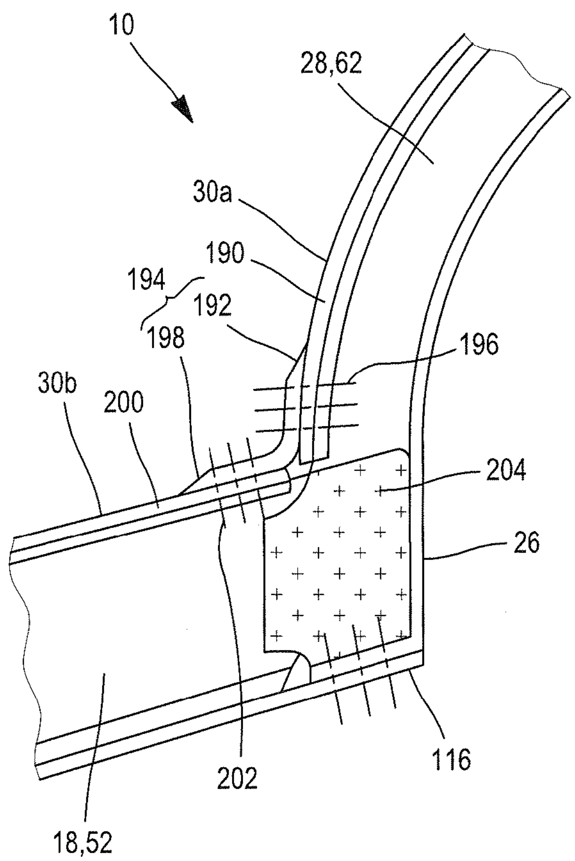
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FIG. 17

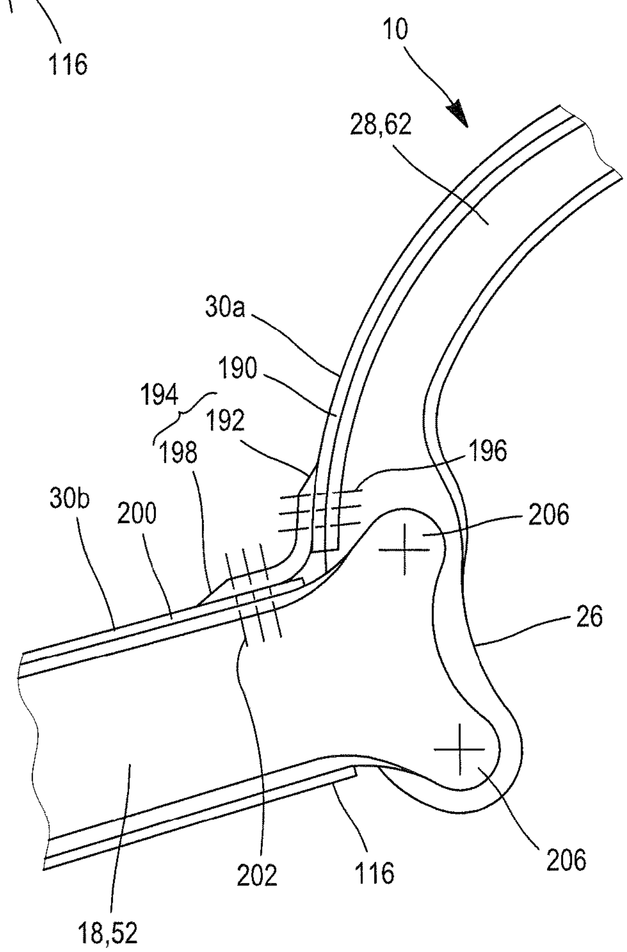
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FIG. 18

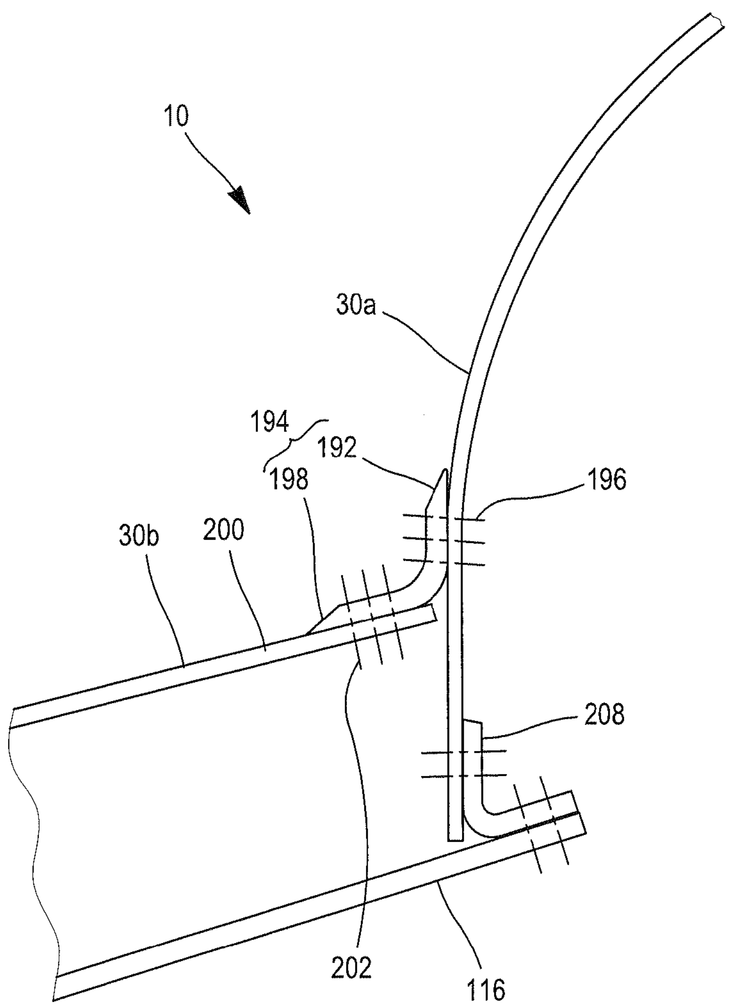

FIG. 19

LATERAL PROPULSION UNIT FOR AIRCRAFT COMPRISING A TURBINE ENGINE SUPPORT ARCH

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims the benefit of the French patent application No. 12 58335 filed on Sep. 6, 2012, the entire disclosures of which are incorporated herein by way of reference.

BACKGROUND OF THE INVENTION

This invention relates to the domain of aircraft propulsion units and most particularly concerns means of attaching turbine engines onto the structure of aircraft.

In aircraft, and particularly in planes, conventional turbojets and open rotor turbojets, are usually supported by an engine mounting structure (EMS) comprising a rigid box shaped structure comprising means of connecting the turbojet to this rigid structure. These connecting means are usually distributed into a forward engine mounting and an aft engine mounting globally centered relative to a median plane of the rigid structure, and two thrust resistance rods located on each side of this median plane.

Engine mounting structures of this type are shown in FIG. 1 in international patent application No. WO2009/147341 A2 for mounting a conventional turbojet under the main wing of an aircraft and in FIGS. 1 and 2 in international patent application WO2010/031959 A1 for the case of an open rotor turbojet mounted on the side of the rear part of an aircraft fuselage.

However, these engine mounting structures do not give an optimum distribution of the means connecting the turbine engine to the rigid structure of these engine mounting structures. These connecting means are concentrated at the distal end of the rigid structure, in other words the end facing the turbine engine.

Thus, it is impossible for these connecting means to resist forces optimally.

Furthermore, this type of configuration limits possibilities of integrating mechanical energy dissipation elements to limit the transmission of vibrations from the turbine engine to the aircraft structure.

This type of configuration also significantly complicates integration of means for controlling turbine engine inclination, particularly upwards or downwards.

Furthermore, engine mountings are usually adjacent to bladed turbine engine rotation wheels. It is thus necessary to make these engine mountings redundant in order to allow for accidental tearing off of one or several blades from such a bladed wheel, also called an UERF (Uncontained Engine Rotor Failure), by adding engine mountings called “failsafe engine mounts” that are not loaded during normal operation, such that if a failure of one or several engine mountings occurs, the other engine mountings will be capable of resisting turbine engine support forces by themselves.

Furthermore, engine mountings located at the distal end of the rigid structure make it necessary to translate the turbine engine approximately along a direction in a median plane of the rigid structure to attach and detach this turbine engine.

If a turbine engine is mounted on the side of a plane fuselage, this median plane of the rigid structure is inclined from the vertical direction such that a complete assembly or disassembly procedure for such a turbine engine includes at least two successive translations, one translation along the vertical direction and one translation along the direction of the median plane of the rigid structure.

It is thus desirable to be able to simplify turbine engine mounting and dismounting procedures.

SUMMARY OF THE INVENTION

The purpose of the invention is particularly to provide a simple, economic and efficient solution to these problems, capable of at least partly overcoming the above-mentioned disadvantages.

To achieve this, the invention proposes a propulsion unit for an aircraft comprising a turbine engine with a longitudinal axis parallel to a longitudinal direction of the turbine engine and an engine mounting device that will be added laterally on an aircraft structure such as a fuselage, said mounting device comprising a rigid mounting structure with a proximal end that will be connected to the aircraft structure and an opposite distal end arranged facing the turbine engine, and said rigid mounting structure supporting connecting means which connect the turbine engine to the rigid mounting structure.

Said connecting means comprise at least one arch concave towards said longitudinal axis and having a proximal end connected to said rigid mounting structure and an opposite distal end.

Furthermore, the proximal and distal ends of the arch extend on each side of a longitudinal plane containing said longitudinal axis and that will extend vertically when said propulsion unit is fitted on an aircraft parked on the ground.

Furthermore, said arch is shaped such that when this arch is seen in a sectional view on a transverse plane orthogonal to said longitudinal axis, two half-lines delimit an angular sector with an angle of between 45 degrees and 120 degrees, wherein the two half lines start from said longitudinal axis, the first half line passing through the distal end of said arch, and the second half line being contained in said longitudinal plane and intercepting said arch.

“Connecting means” connecting the turbine engine to the rigid mounting structure refers to means capable of transmitting forces resulting from the turbine engine support and forces resulting from the thrust generated by the turbine engine, to the rigid mounting structure.

Furthermore, throughout this description, the “proximal” or “distal” nature of an element relates to the distance of this element from the end of the rigid mounting structure that will be connected to an aircraft structure. Thus, when the propulsion unit is fitted on an aircraft, “proximal” means that the element is at the near end to said aircraft structure and “distal” means that the element is at the far end from said aircraft structure.

The longitudinal direction of the turbine engine or the propulsion unit is defined as being the direction of the above-mentioned longitudinal axis of this turbine engine.

The arrangement of the two half-lines mentioned above reflects the angular distance of the distal end of the arch from said longitudinal plane.

In general, the invention can improve the distribution of turbine engine connecting means.

These connecting means include the above-mentioned arch and are therefore distributed over a given circumferential range about the longitudinal axis of the turbine engine.

According to the invention, said connecting means comprise a distal connecting element connecting the turbine engine to a distal mounting part of said arch arranged on the same side of said longitudinal plane as said distal end of said arch, said distal mounting part being arranged such that when said arch is seen in a sectional view along said transverse plane, said distal mounting part extends outside an angular sector with an angle between 25 degrees and 100 degrees having said longitudinal axis as vertex and extending from said second half-line towards said distal end of said arch.

The arrangement of the distal connecting element on the opposite side of the rigid mounting structure, relative to a vertical plane passing through the longitudinal axis of the turbine engine, has advantageous capabilities for resisting turbine engine forces and for damping turbine engine vibrations.

In this regard, said distal connecting element is preferably arranged at a distal end of said arch.

In one preferred embodiment of the invention, said connecting means also comprise a proximal connecting element connecting the turbine engine to a proximal mounting part of said arch, said proximal mounting part being arranged such that when said arch is seen in a sectional view on said transverse plane, said proximal mounting part extends outside an angular sector with an angle of between 25 degrees and 100 degrees, with said longitudinal axis as vertex, and extending from said second half-line towards said rigid mounting structure.

The proximal connecting element and the distal connecting element mentioned above are preferably arranged symmetrically about said longitudinal plane.

Preferably, said distal connecting element and/or said proximal connecting element is/are a mechanical energy dissipation element that will damp turbine engine vibrations.

As a variant, one and/or the other of these connecting elements may be an engine mounting.

In general, said connecting means connecting said turbine engine to said rigid mounting structure preferably comprise a plurality of engine mountings that are capable of jointly resisting all connecting forces of the turbine engine to the rigid mounting structure, and arranged so as to enable referencing of the turbine engine relative to the rigid mounting structure, by displacement of the turbine engine from the ground in translation along the vertical direction.

"Referencing" the turbine engine means positioning the turbine engine in its functioning position, such position being suitable for attachment of the above-mentioned engine mountings to the turbine engine.

Dismounting the turbine engine from its functioning position, and conversely its connection to the mounting device from the ground, can thus be achieved by simple displacement of the turbine engine in translation along the vertical direction.

To achieve this, said connection means connecting the turbine engine to the rigid mounting structure are preferably entirely integrated into a region of space delimited by two half-planes each delimited by said longitudinal axis and extending symmetrically on each side of a longitudinal plane containing said longitudinal axis and that will extend vertically when said propulsion unit is installed on an aircraft parked on the ground, each of said half-planes forming an angle of less than 120 degrees with said longitudinal plane, said region in space being designed to extend above said half-planes when said propulsion unit is installed on an aircraft parked on the ground.

In general, said rigid mounting structure is preferably in the form of a box, in other words an assembly of braced spars and ribs.

Furthermore, the above-mentioned arch advantageously prolongs a spar in said rigid mounting structure.

This spar in said rigid mounting structure preferably forms a first end of said rigid mounting structure, along the longitudinal direction of the turbine engine.

Furthermore, said connecting means advantageously have another arch concave towards said longitudinal axis of the turbine engine and with a distal end extending on the side of said longitudinal plane opposite said rigid mounting structure, said other arch being shaped such that when it is seen in section along said transverse plane, two half-lines starting from said longitudinal axis, the first of which passes through the distal end of said arch and the second of which is contained in said longitudinal plane and intercepts said other arch, together delimit an angular sector with an angle of between 45 degrees and 120 degrees.

This other arch may have one or several of the optional characteristics described above related to the above-mentioned first arch.

In particular, this other arch preferably prolongs another spar of said rigid mounting structure.

Furthermore, said other spar advantageously forms a second end opposite said first end of said rigid mounting structure.

In general, the presence of said other arch can further improve the distribution of said connecting means.

Furthermore, said connecting means advantageously comprise a longitudinal beam supported by each arch connected to said rigid mounting structure.

Such a longitudinal beam can stiffen said arches and further improve the distribution of connecting means.

The connection between this longitudinal beam and each arch may for example be made by embedding this beam into a notch or an orifice formed in a transverse web of the arch.

The longitudinal beam is preferably centered relative to said longitudinal plane.

Furthermore, this longitudinal beam also preferably comprises at least one engine mounting.

This engine mounting is preferably flexible, in other words it is elastic along its working direction.

Such an engine mounting may facilitate damping of turbine engine vibrations by means of shock absorbers working along the working direction of said engine mounting.

To achieve this, the longitudinal beam preferably comprises one or several shock absorbers arranged on a portion of the beam between the two arches mentioned above.

Said longitudinal beam advantageously supports an engine mounting with an actuator capable of modifying the inclination of the longitudinal axis of the turbine engine in said longitudinal plane.

A modification of the inclination of the longitudinal axis of the turbine engine can actually contribute to reducing noise nuisance of the turbine engine.

In the preferred embodiment of the invention, said longitudinal beam supports an additional arch offset along the longitudinal direction of the turbine engine, from said rigid mounting structure, and preferably centered relative to said longitudinal plane.

Said additional arch advantageously supports two lateral engine mountings arranged on each side of said longitudinal plane and designed to resist forces oriented along the vertical direction.

These engine mountings are preferably flexible, in other words they are elastic along the vertical direction.

Furthermore, the additional arch preferably supports a central engine mounting centered relative to said longitudinal plane and designed to resist at least forces along a transverse direction of the turbine engine.

"Transverse direction" means a direction orthogonal to said longitudinal plane.

This central engine mounting supported by the additional arch preferably comprises a shear pin with an approximately vertical axis fixed to one of the elements among the turbine engine and the additional arch, while being inserted in a hole formed in the other of these elements.

In the preferred embodiment of the invention, said central engine mounting supported by the additional arch is also designed to resist forces oriented along the longitudinal direction of the turbine engine.

As a variant, said rigid mounting structure may support an engine mounting at its distal end designed to resist forces applied along the longitudinal direction of the turbine engine.

Furthermore, said longitudinal beam preferably supports an engine mounting arranged on the longitudinal side of said rigid mounting structure opposite the additional arch, designed to resist at least forces oriented along the vertical direction.

In this case, the term "engine mounting" should be understood in the broad sense, including the case of a combination of several elements such as connecting rods working in separate directions but the combination of which can resist vertical forces.

In the preferred embodiment of the invention, such an engine mounting also resists the moment about the transverse direction, working in cooperation with lateral engine mountings supported by the additional arch.

Furthermore, in the preferred embodiment of the invention, said rigid mounting structure comprises an engine mounting at its distal end designed to resist forces applied along the transverse direction of the turbine engine.

As a variant, said engine mounting supported by said longitudinal beam and arranged on the longitudinal side opposite said additional arch, may also be designed to resist forces applied along the transverse direction of the turbine engine.

In general, said connecting means preferably comprise a plurality of mechanical energy dissipation elements connecting each above-mentioned arch to the turbine engine, said plurality of mechanical energy dissipation connecting elements comprising at least the distal connecting element described above, and one upper connecting element centered relative to said longitudinal plane.

Furthermore, the above-mentioned propulsion unit also advantageously comprises an external aerodynamic fairing.

"External aerodynamic fairing" means a fairing surrounded by relative wind circulating outside the propulsion unit.

This external aerodynamic fairing preferably comprises a structural skin that covers and is fixed to each arch connected to said rigid mounting structure, in which case said connecting means are sized such that a part of the connecting forces from the turbine engine to said rigid mounting structure passes through said structural skin of the aerodynamic external fairing.

Since some of the forces pass through the structural skin of the external aerodynamic fairing, the capacity of the above-mentioned connecting means to resist these forces may be reduced. The weight of elements such as arches, the additional arch and the longitudinal beam described above can thus be reduced.

Furthermore, the structural skin of the external aerodynamic fairing preferably extends as far as the distal end of each above-mentioned arch.

Preferably, this structural skin of the external aerodynamic fairing is connected to an upper aerodynamic skin that covers and is fixed onto at least part of said rigid mounting structure.

The invention also relates to an aircraft such as a plane, comprising at least one propulsion unit of the type mentioned above.

Preferably, each arch connected to said rigid mounting structure comprises a part extending above the turbine engine of said propulsion unit when said aircraft is parked on the ground.

Finally, the invention relates to a method for dismounting a turbine engine from a propulsion unit of an aircraft of the type described above, and a method of mounting a turbine engine initially placed on the ground, onto such a propulsion unit.

Each of these methods comprises a displacement of the turbine engine between a service position in which the turbine engine is mounted onto the mounting structure of said propulsion unit, and a dismounted position in which the turbine engine is placed on the ground.

According to the invention, said displacement is a translation along the vertical direction.

The turbine engine can be dismounted from its service position, and conversely can be connected to the mounting device from the ground, with a simple displacement of the turbine engine in translation along the vertical direction.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and other details, advantages and characteristics of it will become clear after reading the following description given as a non-limitative example with reference to the appended drawings in which:

FIG. **1** is a diagrammatic cross-sectional view of an aft part of an aircraft fitted with two propulsion units according to one preferred embodiment of the invention, these propulsion units being added laterally onto the aircraft fuselage;

FIG. **2***a* is a diagrammatic perspective top view of one of the propulsion units of the aircraft in FIG. **1**, this propulsion unit comprising a turbine engine, a mounting device for this turbine engine, and an external aerodynamic fairing;

FIG. **2***b* is a diagrammatic perspective bottom view of the propulsion unit in FIG. **2***a;*

FIG. **3** is a diagrammatic perspective top view of a rigid mounting structure and a rigid substructure that form part of the mounting device of the propulsion unit in FIG. **2***a;*

FIG. **4***a* is a cross-sectional diagrammatic view along plane P in FIG. **3**, of a forward arch forming part of the rigid substructure in FIG. **3**;

FIG. **4***b* is a diagrammatic perspective view of an additional arch forming part of the rigid substructure in FIG. **3**;

FIG. **5** is a partial diagrammatic perspective bottom view of the mounting device of the propulsion unit in FIG. **2***a*, to which a structural skin of the external aerodynamic fairing of this propulsion unit has been added;

FIG. **6** is a partial diagrammatic top view of the mounting device of the propulsion unit in FIG. **2***a*, to which the structural skin of said external aerodynamic fairing has been added;

FIGS. **7** and **8** are partial perspective diagrammatic views of the propulsion unit in FIG. **2***a* seen from the front of the aircraft;

FIGS. **9** and **10** are partial perspective diagrammatic views of the propulsion unit in FIG. **2***a*, at a larger scale, showing a forward upper engine mounting resisting vertical forces and a lateral engine mounting resisting transverse forces;

FIG. **11** is a partial diagrammatic view of the propulsion unit in FIG. **2***a*, seen from the aft part of the aircraft;

FIG. **12** is a partial diagrammatic view of detail XII in FIG. **11** at a larger scale, showing an aft lateral engine mounting resisting vertical forces;

FIG. **13** is a partial diagrammatic view from the forward part of the aircraft, of the propulsion unit in FIG. **2***a*, showing a method of dismounting the turbine engine from this propulsion unit;

FIG. **14** is a partial diagrammatic perspective view of a propulsion unit according to another embodiment of the invention, seen from the front of the aircraft, more particularly illustrating a forward upper engine mounting of this propulsion unit;

FIG. **15** is a partial diagrammatic cross-sectional view of a propulsion unit according to another embodiment of the invention;

FIG. **15***a* is a longitudinal sectional view along plane A-A in FIG. **15** shown at larger scale, of a lateral engine mounting of the propulsion unit in FIG. **15**;

FIG. **16** is a partial diagrammatic perspective view of an aft upper engine mounting of the propulsion unit in FIG. **15**;

FIG. **17** is a partial diagrammatic cross-sectional view of a propulsion unit according to another embodiment of the invention showing the connection zone of the rigid substructure to the rigid mounting structure of the mounting device in this propulsion unit;

FIG. **18** is a view similar to FIG. **17**, showing a variant embodiment of the propulsion unit;

FIG. **19** is a view similar to FIG. **17** of the propulsion unit in this FIG. **17** seen along a sectional plane shifted longitudinally from the plane in FIG. **17**.

In all these figures, identical references may denote identical or similar elements.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** very diagrammatically shows an aft part of an aircraft **8** such as a plane seen in a cross-sectional view comprising two propulsion units **10** added laterally on the aircraft fuselage **11**. These propulsion units **10** are thus arranged aft from the main wings of the aircraft (not visible in FIG. **1**).

Each propulsion unit **10** globally comprises a turbine engine **12** (FIG. **2***b*), a mounting device **14** fixing the turbine engine to an aircraft structure (FIGS. **2***a* and **2***b*), and an external aerodynamic fairing **16** that will guide the external airflow, also called the relative wind, around the turbine engine **12**.

In the example shown, the turbine engine **12** is an open rotor pusher type turbojet, with propellers located in an aft part of the turbojet, these propellers not being shown in the figures.

Throughout the remainder of the description, by convention, X is the longitudinal direction of the turbine engine **12** and more generally of the propulsion unit **10** and the aircraft **8**, this longitudinal direction X being parallel to a longitudinal axis **17** of the turbine engine **12**. The Z axis is the direction of the height corresponding to the vertical direction when the aircraft **8** is parked on the ground or is in a zero roll position in flight, and Y is the transverse direction of the propulsion unit **10**. The three directions X, Y and Z are orthogonal to each other.

Furthermore, the terms "forward" and "aft" should be considered relative to a direction of progress of the aircraft **8**, shown diagrammatically by the arrow F.

The terms "distal" and "proximal" represent the fact that the element is far from or close to the aircraft fuselage respectively.

The mounting device **14** comprises a rigid mounting structure **18** and a leading edge fairing **20** and trailing edge fairing **22** that are added onto forward and aft ends of the rigid mounting structure **18** respectively.

The rigid mounting structure **18** has a proximal end **24** that will be connected laterally to the fuselage **11** of the aircraft **8**, and an opposite distal end **26** that extends facing the turbine engine **12**.

The mounting device **14** also comprises a rigid substructure **28** added to the distal end **26** of the rigid mounting structure **18**.

The rigid mounting structure **18** comprises a forward spar **52**, a median spar **54** and an aft spar **56**, and three internal ribs **58** and a closing rib **60** (see FIG. **4**). Thus, the rigid mounting structure **18** is in the form of a box.

In a manner known in itself, each of the above-mentioned spars is for example in the form of an I-shaped beam and thus comprises a web **61***a* extending approximately along a plane orthogonal to the longitudinal axis **17** of the turbine engine, a bottom flange **61***b* and a top flange **61***c* connected respectively to lower and upper edges of the web **61***a* and extending approximately along planes parallel to the longitudinal axis **17** of the turbine engine and orthogonal to the web **61***a*.

The rigid substructure **28** comprises two approximately identical arches, namely a forward arch **62** and an aft arch **64**. These two arches have proximal ends **66***a* connected to distal ends **68** of the corresponding forward spar **52** and aft spar **56** mentioned above, and corresponding opposite distal ends **66***b*. These two arches **62** and **64** are curved elements each of which is concave towards the longitudinal axis **17** of the turbine engine, as can be seen in FIG. **4***a*.

The forward arch **62** continues beyond a longitudinal plane V (FIGS. **3**, **4***a*) containing the longitudinal axis **17** and that will extend vertically when the aircraft **8** is parked on the ground. The circumferential extent of the forward arch **62** is quantified by an angle θ1 formed by two half-lines D1 and D2 each extending starting from the longitudinal axis **17**. The first half-line D1 passes through the distal end **66***b* of the forward arch **62**, while the second half-line D2 is contained in the longitudinal plane V and intercepts the forward arch **62**.

The angle θ1 of the angular sector delimited by the two half-lines D1 and D2 is equal to approximately 100 degrees. This angle θ1 is preferably between 45 degrees and 120 degrees.

According to one variant, the circumferential extent of the forward arch **62** is quantified considering that a radially internal edge of the arch seen in section along the transverse plane P in FIG. **3**, extends towards the distal end **66***b* of the arch from an upper edge **70** of the closing rib **60** of the rigid mounting structure **18**. The radially internal edge of the forward arch **62** thus defined has a circumferential extent equal to about 200 degrees about the longitudinal axis **17** of the turbine engine.

The properties described above concerning the forward arch **62** are obviously valid for the aft arch **64**.

The rigid substructure **28** also comprises a longitudinal beam **72** (FIG. **3**) centered relative to the longitudinal plane V. This longitudinal beam **72** is embedded in a median portion of each of the forward **62** and aft **64** arches.

The rigid substructure **28** also comprises a median half-arch **74** with a proximal end **76** connected to a distal end **78** of the median spar **54** of the rigid mounting structure **18**, and a distal end **80** connected to a lateral side of the longitudinal beam **72**. This median half-arch **74** is shaped such that its distal end **80** is offset along the aft direction from its proximal end **76**.

Each of the forward **62** and aft **64** arches comprises a web **81***a* extending along the line of the web **61***a* of the corresponding spar **52**, **56** and an inner flange **81***b* and an outer flange **81***c* connected to the inside and outside edges respectively of the web **81***a* of the arch. The outer flange **81***c* of each of the arches **62**, **64** extends along the line of the upper flange **61***c* of the corresponding spar **52**, **56** to the distal end **66***b* of the arch, while the inner flange **81***b* of the arch extends along the line of the upper edge **70** of the closing rib **60** of the rigid mounting structure **18** as far as the longitudinal beam **72**. The web **61***a* of each arch is thus in a transverse plane, while the inner flange **81***b* and the outer flange **81***c* of each arch are approximately in the shape of a portion of a cylinder of revolution about the longitudinal axis **17**.

Similarly, the median half-arch **74** comprises a web **81***a* extending along the line of the web **61***a* of the median spar **54**, and an inner flange **81***b* and an outer flange **81***c* connected to the inner and outer edges respectively of the web **81***a* of the arch. The outer flange **81***c* of the median half-arch **74** extends in line with the upper flange **61***c* of the median spar **54** as far as the longitudinal beam **72**, and the inner flange **81***b* of the median half-arch extends along the upper edge **70** of the closing rib **60** of the rigid mounting structure **18**, also as far as the longitudinal beam **72**.

The rigid substructure **28** also comprises an additional arch **82** added onto an aft end **84** of the longitudinal beam **72** and forming an aft end of the rigid substructure **28**. As shown in FIG. **3**, the additional arch **82** is offset in the aft direction from the rigid mounting structure **18**, and extends over about 60 degrees about the longitudinal axis **17** of the turbine engine, being centered relative to the longitudinal plane V.

As can be seen in FIG. **3**, the rigid substructure **28** also comprises two stiffener arches **86** that connect two opposite lateral ends **88** of the additional arch **82** to the longitudinal beam **72**.

The forward arch **62** and the forward spar **52** are preferably made of metal and are fixed to each other by electron welding of their corresponding proximal end **66***a* and distal end **68**, in a welding zone **90** (FIG. **4***a*).

As a variant, the forward arch **62** and the forward spar **52** may be fixed to each other by other means, for example by splicing.

These features of the forward arch **62** and the forward spar **52** are also applicable to the aft arch **64** and to the aft spar **56**, and to the median half-arch **74** and to the median spar **54**.

As can be seen in FIG. **4***a*, the forward spar **52** comprises openings **92** to reduce the weight of the spar. The forward arch **62** also comprises openings **94** distributed in a proximal half of the arch.

Furthermore, the forward arch **62** comprises three clevises projecting radially inwards from the longitudinal axis **17** of the turbine engine and designed for mounting energy dissipation elements as will become clearer in the following description. One of these clevises **96***a* is located at the vertex of the forward arch **62** while the other two clevises **96***b* and **96***c* are located at the proximal end and distal end respectively of the arch so as to be diametrically opposite to each other on opposite sides of the longitudinal axis **17** of the turbine engine.

The additional arch **82** is shown in more detail in FIG. **4***b*. It comprises two clevises **98***a* and **98***b* forming the opposite lateral ends respectively of the additional arch **82**, each designed for the attachment of a corresponding engine mounting. The additional arch **82** also comprises a portion **100** of the aft central engine mounting that is centered relative to the longitudinal plane V and that essentially comprises a hole **102** with a vertical axis into which a force transmission pin will be fitted, as will become clearer in the following.

The additional arch **82** is preferably made from a metallic material and is advantageously formed from three segments assembled end to end, for example by an electron beam welding technique in welding zones **104** roughly shown in FIG. **4***b*. As a variant, these segments may be attached by splicing.

In the example shown, the additional arch **82** is approximately in the shape of an I section and it is composed principally of a web **106***a* extending approximately along a plane orthogonal to the longitudinal axis **17** of the turbine engine, and an inner flange **106***b* and an outer flange **106***c* connected to the inner and outer edges respectively of the web **106***a* of the additional arch **82** and in the form of portions of a cylinder of revolution with axes coincident with the longitudinal axis **17** of the turbine engine. In this example, the outer flange **106***c* extends continuously from one end of the additional arch **82** to the other, while the inner flange **106***b* comprises two disconnected portions **108** and **110** extending from the two opposite ends of the additional arch towards a median part of the arch.

Furthermore, as can be seen in FIGS. **3** and **4***b*, the additional arch **82** comprises a connector portion **112** formed projecting in the forward direction along the axial direction from the portion **100** of the aft central engine mounting integrated into this additional arch. This connector portion **112** has a plane end face **114** extending orthogonally to the longitudinal axis **17** of the turbine engine, that will be fixed on a corresponding end face of the longitudinal beam **72** such that the connector portion **112** mentioned above extends said beam.

Furthermore, the external aerodynamic fairing **16** comprises a structural skin **30***a* (FIGS. **2***a*, **2***b*, and **5**) that has an approximately semi-cylindrical aerodynamic shape of revolution, and which is fixed on the rigid substructure **28**.

It should be noted that the structural skin **30***a* is concave towards the direction of the longitudinal axis **17** of the turbine engine **12** when the propulsion unit **10** is seen in section along a transverse plane, in other words orthogonal to the longitudinal direction X, like the transverse plane P visible in FIG. **3**.

In the example shown, the structural skin **30***a* has a circumferential extent equal to about 190 degrees about the longitudinal axis **17** when the propulsion unit **10** is seen in section in a transverse plane such as the plane P in FIG. **3**. More generally, this circumferential extent is preferably between 90 degrees and 230 degrees.

Preferably, the structural skin **30***a* is arranged so that most of it is above the longitudinal axis **17** of the turbine engine when the aircraft **8** is parked on the ground. More precisely, this structural skin **30***a* is preferably entirely included in a region R of the space delimited by two half planes P**1**, P**2** each delimited by the longitudinal axis **17** and extending symmetrically on each side of the longitudinal plane V, as can be seen in FIG. **4***a*. Under these conditions, said region R of the space will extend above the half planes P**1**, P**2**. Furthermore, each of the half planes P**1**, P**2** forms an angle β that is advantageously less than 120 degrees with the longitudinal plane V. In the example shown, the angle β is thus equal to about 105 degrees.

The mounting device **14** also comprises an upper aerodynamic skin **30***b* with an approximately plane aerodynamic shape extending laterally along a line of the structural skin **30***a* mentioned above so as to cover an upper face of the rigid mounting structure **18** (FIGS. **2***a*, **2***b*, and **5**).

The structural skin **30***a* and the upper aerodynamic skin **30***b* are made from a composite thermosetting or thermoplastic type material, but as a variant may be made from metal. In the case of a thermosetting material, these skins may be made in particular using an automatic layup machine using a method known to those skilled in the art for manufacturing single or double curvature fuselage panels.

Apart from the structural skin **30***a*, the external aerodynamic fairing **16** also comprises a lower cowling **32**, an air inlet **34** and complementary panels **36** (FIGS. **2***a* and **2***b*).

The lower cowling **32** comprises a distal end **42** articulated onto a distal end **44** of the rigid substructure **28** and a proximal end **46** provided with connecting means to the rigid mounting structure **18**. The lower cowling **32** can thus be changed over from an open position shown in FIGS. **2***a* and **2***b* in which the proximal end **46** of the lower cowling is detached from the rigid mounting structure **18**, to a closed position in which the proximal end **46** of the lower cowling is connected to this rigid mounting structure **18**.

The air inlet **34** is connected to a forward end of the rigid substructure **28**. This air inlet **34** comprises a globally annular outer skin **48** centered relative to the longitudinal axis **17** of the turbine engine and prolonging the structural skin **30***a* and the lower cowling **32** when the lower cowling is in the closed position. The air inlet **34** also comprises a globally annular inner skin delimiting the outside of an air inlet conduit into the turbine engine **12**.

Each of the complementary panels **36** mentioned above is connected to one or several elements of the mounting device **14**, including the structural skin **30***a*, the leading edge fairing **20** and the trailing edge fairing **22**, the lower cowling **32** and the air inlet **34**, so as to fill in the spaces between these elements.

Furthermore, the structural skin **30***a* is mounted on the rigid substructure **28** by bolting or riveting this structural skin **30***a* onto the outer flanges **81***c*, **106***c* of the arches **62**, **64**, of the half-arch **74** and the additional arch **82** of the rigid substructure **28**, respectively.

Similarly, the upper aerodynamic skin **30***b* is fixed onto the rigid mounting structure **18** by bolting or riveting of this upper aerodynamic skin **30***b* onto the corresponding upper flanges **61***c* of the spars **52**, **54**, **56** of the rigid mounting structure **18**.

The elements forming the rigid substructure **28**, and particularly the forward arch **62** and aft arch **64** and the longitudinal beam **72** and the median half-arch **74** are sized such that some of the forces induced by the turbine engine **12** are transmitted from this turbine engine to the rigid mounting structure **18** through the structural skin **30***a* of the outer aerodynamic fairing **16**. This design is thus intended to limit the stiffness of elements forming the rigid substructure **28**, for example by limiting the cross section of these elements and/or by limiting the Young's modulus by an appropriate choice of the material(s) from which these elements are made. Furthermore, the above-mentioned elements that form the rigid substructure **28** and the rigid mounting structure **18** are sized such that some of the forces induced by the turbine engine **12** are transmitted to the rigid mounting structure **18** through the upper aerodynamic skin **30***b*.

As shown in FIG. **5**, the underside of the rigid mounting structure **18** is covered by fairing consisting of a lower aerodynamic skin **116** of the mounting device **14**, fixed on the corresponding lower flanges **61***b* of the spars of the rigid mounting structure **18**. This lower skin **116** is provided with inspection openings **118** allowing access inside the propulsion unit **10** and provided with removable covers not shown in the figures. The closing rib **60** of the rigid mounting structure **18** also comprises such inspection openings **118**.

Furthermore, the mounting device **14** comprises an inner skin **120** fixed on the corresponding inner flanges **81***b* of the forward arch **62** and the aft arch **64** and the median half-arch **74**. This inner skin **120** forms a stiffening panel that participates in stiffening the rigid substructure **28**.

The connection between the rigid substructure **28** and the turbine engine **12** is made by a plurality of first devises used for mounting mechanical energy dissipation elements, called shock absorbers in the following, and a plurality of second clevises for attachment of engine mountings as well as the portion **100** of the aft central engine mounting integrated into the additional arch **82**.

The plurality of first clevises includes the three clevises **96***a*, **96***b*, **96***c* in the forward arch **62**, already described, and two clevises supported by the aft arch **64**, one **122***a* of which is located at the vertex of the arch while the other **122***b* is located at the distal end **66***b* of the arch, and another clevis **124** supported by the longitudinal beam **72** and located between the forward arch **62** and the median half-arch **74**. The axis of each of these first clevises is parallel to the longitudinal axis **17** of the turbine engine.

It should be noted that the first clevises **96***c* and **122***b* that form part of the forward arch **62** and the aft arch **64** respectively form distal mounting parts located on the same side as the distal end **66***b* of each arch relative to the longitudinal plane V, using the terminology applicable for the invention.

As can be seen in FIG. **4***a*, each of the distal mounting parts **96***c* and **122***b* mentioned above extends outside an angular sector with angle θ2 equal to about 80 degrees extending from the second half-line D2 described above towards the distal end **66***b* of the corresponding arch. The above-mentioned angle θ2 is preferably between 25 degrees and 100 degrees.

Furthermore, using to the terminology applicable for the invention, the first clevis **96***b* forming part of the forward arch **62** forms a proximal mounting part arranged on the same side as the proximal end **66***a* of the arch and the rigid mounting structure **18** relative to the longitudinal plane V.

FIG. **4***a* shows the above-mentioned proximal mounting part **96***b* extending outside an angular sector with angle θ3 equal to about 80 degrees and extending from the second half-line D2 towards the rigid mounting structure **18**. The above-mentioned angle θ3 is preferably between 25 degrees and 100 degrees.

The plurality of second clevises includes the two clevises **98***a* and **98***b* forming the ends of the additional arch **82**, and a clevis **126** supported by the longitudinal beam **72** and located approximately at the forward end of this beam, and a clevis **128** supported jointly by the proximal end of the median half-arch **74** and by the distal end **78** of the median spar **54**. Each second clevis has an axis parallel to the longitudinal axis **17** of the turbine engine, except for the clevis **126** located in the forward part of the longitudinal beam **72**, that has an axis parallel to the transverse direction Y.

Each of the first and second clevises mentioned above extends projecting radially inwards towards the longitudinal axis **17** of the turbine engine.

As can be seen in FIG. **6**, the structural skin **30***a* comprises inspection openings **130**, for example four inspection openings. These inspection openings are provided with removable covers not shown in the figures. One of these inspection openings is formed facing an inspection opening **132** formed in the inner skin **120** of the mounting device **14** and can also be seen in FIG. **5**.

The manner in which the turbine engine **12** is connected to the mounting device **14** will now be described with reference to FIGS. **7** to **12**.

In these figures, the engine mountings and the energy dissipation elements for connection of the turbine engine **12** to the rigid substructure **28** and the rigid mounting structure **18** are shown by functional symbols unrelated to the geometry of these elements, considering that these elements may be of a known type, so that their structure will not be described in detail in the following.

FIGS. **7** to **9** show firstly a forward upper engine mounting **134** connecting the clevis **126** supported by the forward end of the longitudinal beam **72** to a similar clevis **136** supported by a forward casing **138** of the turbine engine **12**. Mounting of this forward upper engine mounting **134** onto the clevises **126** and **136** is such that this engine mounting transmits only forces oriented along the vertical direction Z to the rigid substructure **28**. To achieve this, the forward upper engine mounting **134** is connected to each of the above-mentioned clevises **126**, **136** using a ball joint.

Forces along the vertical direction Z are also resisted by two aft lateral engine mountings **140***a* and **140***b* that can be seen in FIG. **11**, connecting the clevises **98***a* and **98***b* forming the lateral ends of the additional arch **82**, to clevises **142***a* and **142***b* respectively with axes parallel to the longitudinal axis **17** of the turbine engine **12** and formed on an aft casing **144** of this turbine engine, projecting radially outwards. These aft lateral engine mountings **140***a* and **140***b* are also connected to the above-mentioned clevises through ball joints to prevent any resistance to forces oriented along the longitudinal X and transverse Y directions.

FIGS. **8** and **10** show a forward lateral engine mounting **146** connecting the clevis **128** supported by the proximal end of the median half-arch **74** to a clevis **148** with axis parallel to the longitudinal axis **17** of the turbine engine and formed on a casing **150** of the turbine engine **12** placed between the forward casing **138** and the aft casing **144** mentioned above, projecting radially outwards. Mounting of this forward lateral engine mounting **146** onto the clevises **128** and **148** is such that this engine mounting only transmits forces along the transverse Y direction to the rigid substructure **28** and to the rigid mounting structure **18**. To achieve this, this forward lateral engine mounting **146** is connected to clevises **128** and **148** through ball joints.

For example, engine mountings **134**, **140***a*, **140***b* and **146** described above are in the form of connecting rods or shackles.

Furthermore, these engine mountings are preferably of the so-called flexible type, in other words they include elastic means allowing relative displacement of the ends of the engine mounting.

The forces along the transverse Y direction are also resisted by an aft central engine mounting **152** (FIG. **11**) comprising the engine mounting portion **100** integrated to the additional arch **82**, and a fitting **154** formed on part of the vertex of the aft casing **144** and fitted with a shear pin **156** with a vertical axis passing through the longitudinal axis **17** of the turbine engine. This shear pin **156**, commonly called a spigot, extends projecting upwards and its upper part is inserted so as to fit in the hole **102** (FIG. **4***b*) of the engine mounting portion **100** integrated into the additional arch **82**. The tight fit of the shear pin **156** in the hole **102** means that the aft central engine mounting **152** resists not only the above-mentioned transverse forces but also thrust forces of the turbine engine **12**, in other words forces along the longitudinal direction X. The shear pin **156** is mounted with some play along the axis of the hole **102** so as to prevent the resistance of forces along the vertical direction Z. Furthermore, the hole **102** is formed in a ball joint (not shown in the figures), itself integrated into the portion **100** of the engine mounting integrated into the additional arch **82**. Such a ball joint connection prevents the transmission of forces or moments related to a rotation of the shear pin **156**.

Furthermore, the moment along the vertical direction Z is resisted jointly by the forward lateral engine mounting **146** and by the aft central engine mounting **152**.

The moment about the transverse direction Y is resisted jointly by the forward upper engine mounting **134** and by the aft lateral engine mountings **140***a* and **140***b*.

Finally, the moment about the longitudinal direction X is resisted by the aft lateral engine mountings **140***a* and **140***b*.

As can be seen in FIGS. **7** and **8**, six mechanical energy dissipation elements **158***a*, **158***b*, **158***c*, or shock absorbers intended to absorb vibrations of the turbine engine **12**, connect the clevises **96***a*, **96***b*, **96***c*, **124**, **122***a*, **122***b* supported by the rigid substructure **28** to clevises **160***a*, **160***b*, **160***c* respectively located on the casings **138** and **150** of the turbine engine **12**.

Each of the two shock absorbers **158***c* connected to the clevis **96***c* arranged at the distal end **66***b* of the forward arch **62** and to the clevis **122***b* arranged at the distal end **66***b* of the aft arch **64** respectively forms a distal connecting element connecting the turbine engine to the corresponding arch, in the terminology specific to the invention.

Similarly, the shock absorber **158***b* connected to the clevis **96***b* arranged at the proximal end of the forward arch **62** forms a proximal connecting element that connects the turbine engine to the forward arch **62**.

As shown in FIG. **12**, the clevis **98***a* that forms one of the ends of the additional arch **82** and that is used for attachment of the aft lateral engine mounting **140***a*, is fixed onto the additional arch **82** by removable attachment elements such as bolts, of which only the corresponding axes **162** are shown. The same applies for the clevis **98***b* forming the other end of the additional arch **82**. To achieve this, each of these two clevises **98***a*, **98***b* has a plate **164** applied onto an end plate **166** of the additional arch **82**, these plates that can also be seen in FIG. **4***b* comprise corresponding orifices aligned to enable the passage of the above-mentioned bolts.

The other clevises **126** and **128** supported by the rigid substructure **28** and that will be used for the attachment of engine mountings are also fixed onto the corresponding element of this rigid substructure by removable attachment means.

The method of attachment by removable attachment means of the clevises designed for attachment of the engine mountings enables attachment/detachment of the turbine engine **12** to/from the mounting device **14** by mounting/dismounting the corresponding clevis of each engine mounting to/from the rigid substructure **28**, rather than by mounting/dismounting the pins of each engine mounting.

Similarly, the clevises **96***a*-**96***c*, **122***a*, **122***b*, and **124** that are designed for the attachment of shock absorbers **158**, are preferably also fixed to the corresponding element of the rigid substructure **28** by removable attachment means.

It should be noted that all of the engine mountings **134**, **140***a*, **140***b*, **146**, **152** and shock absorbers **158** and the rigid substructure **28** jointly form means of connecting the turbine engine **12** to the rigid mounting structure **18**, in the terminology specific to the invention.

As shown diagrammatically in FIG. **13**, the turbine engine **12** may be mounted onto the mounting device **14** and dismounted from it by displacement of the turbine engine **12** in translation only along the vertical direction, symbolically shown by the arrow **168**. It should be noted that the turbine engine **12** is shown without its engine mountings **134**, **140***a* and **140***b* in FIG. **13**, for reasons of clarity.

Therefore, this method of mounting and dismounting the turbine engine has the advantage that it does not require several successive translations along different directions, and is facilitated by the fact that the means of connecting the turbine engine **12** to the rigid mounting structure **18** are entirely located within the region R of space defined above (FIG. **4a**).

In particular, it should be noted that no engine mounting is connected to a lower part of the turbine engine **12**. The same applies for the shock absorbers **158**. More precisely, none of the engine mountings is entirely located within a half-space defined under a plane passing through the longitudinal axis **17** and parallel to the transverse direction Y. All engine mountings are located within a defined half space above the above-mentioned plane, except for the forward lateral engine mounting **146** that is shared by the above-mentioned plane into two parts approximately symmetric with each other.

Furthermore, FIG. **6** shows a zone **170** commonly called the "UERF" zone defined as the zone that could be impacted by a blade of the turbine engine **12** in case such a blade is torn off.

It can be seen in this FIG. **6** that the additional arch **82** is located outside the UERF zone **170**. Consequently, the aft lateral engine mountings **140a**, **140b** and the aft central engine mounting **152** are protected from the impact of a blade.

Furthermore, since the forward upper engine mounting **134** is designed to resist vertical forces only, this engine mounting has some play along the transverse direction Y at the devises **126** and **136** (FIG. **9**) to which this engine mounting is connected. However, if the forward lateral engine mounting **146** that will resist transverse forces and participate in resisting the moment about the vertical direction Z should accidentally be destroyed, the forward upper engine mounting **134** naturally tends to stop in contact with the clevises **126** and **136** as it displaces along the transverse direction Y, and thus substitutes for the deficient engine mounting to resist the moment about the vertical direction Z jointly with the aft lateral engine mountings **140a** and **140b** located outside the UERF zone **170**.

Similarly, the forward lateral engine mounting **146** that will resist forces along the transverse direction Y has some play along the vertical direction Z at the clevises **128** and **148** (FIG. **10**) to which this engine mounting is connected. However, if the forward upper engine mounting **134** that will resist vertical forces and participate in resisting the moment about the transverse direction Y should be accidentally destroyed, the forward lateral engine mounting **146** naturally tends to stop in contact with the clevises **128** and **148** as it displaces vertically, and thus substitutes for the defective engine mounting to resist the moment about the transverse direction Y jointly with the aft lateral engine mountings **140a** and **140b** located outside the UERF zone **170**.

The configuration of the propulsion unit **10** thus satisfies the regulatory requirements regarding the risk of the loss of blade, while avoiding the use of additional "failsafe" engine mountings that do not participate in resisting forces during normal operation of the turbine engine.

As a variant, the spars **52**, **54**, **56** and/or the ribs **58**, **60** of the rigid mounting structure **18** may be made of a composite material rather than metal.

As another variant, the rigid mounting structure **18** does not necessarily comprise spars and ribs but may be made of a honeycomb structure, or it may be formed from a solid foam.

Furthermore, the structural skin **30a** may have a circumferential extent less than the circumferential extent of the rigid substructure **28**. This rigid substructure is then only partially covered by the structural skin **30a**.

Furthermore, although the lower cowling **32** described above only performs an aerodynamic function and does not participate in the transmission of forces induced by the turbine engine, as a variant it would be possible to design this lower cowling **32** and the component elements of the mounting device **14** such that the lower cowling **32** does play a structural role, in other words it does participate in the transmission of forces induced by the turbine engine, particularly in transmission of the torsion moment about the longitudinal direction X.

Furthermore, the engine mounting portion **100** containing the hole **102** is not necessarily integrated into the additional arch **82** but it may be in the form of a fitting added on this additional arch and including the hole **102**.

Furthermore, the forward upper engine mounting **134** may be replaced or extended by a linear actuator to modify the inclination of the longitudinal axis of the turbine engine **12** along the horizontal direction. Such a modification of the inclination is facilitated by the fact that the aft central engine mounting **152** comprises a ball joint, as explained above.

FIG. **14** shows a propulsion unit **10** according to another embodiment of the invention, in which the mounting device **14** does not include any forward lateral engine mounting like the engine mounting **146** described above, but it comprises two forward upper engine mountings **72a** and **172b** connecting the two clevises **174a**, **174b** fixed to the forward casing **138** of the turbine engine **12** to a spreader **176** itself attached to a fitting **178** supported by the longitudinal beam **72**. The two clevises **174a**, **174b** mentioned above are arranged on each side of the longitudinal plane V, such that the two forward upper engine mountings **172a** and **172b** are arranged approximately in an inverted "V" configuration. The spreader **176** has two clevises **180a**, **180b** also arranged on each side of the longitudinal plane V, in line with the two clevises **174a**, **174b** respectively fixed to the forward casing **138**. Each of these forward upper engine mountings **172a** and **172b** is connected to the corresponding clevis **174a**, **174b** of the forward casing **138** through a ball joint connection, and to the corresponding clevis **180a**, **180b** of the spreader **176** through a pivot connection. Furthermore, the spreader itself is connected to the fitting **178** supported by the longitudinal beam **72** through a ball joint connection with some play along the longitudinal direction X.

The two forward upper engine mountings **172a** and **172b** can thus jointly resist forces along the vertical direction Z and forces along the transverse direction Y.

FIGS. **15** and **16** show a propulsion unit **10** according to another embodiment of the invention, in which the mounting device **14** comprises a lateral engine mounting **182** designed to resist forces along the longitudinal direction X, and not to resist forces along the transverse direction Y as in the previous embodiments described above.

This lateral engine mounting **182** comprises a ferrule **184** fixed on the rigid mounting structure **18**, for example on the distal end **78** of the median spar **54**. This ferrule **184** comprises a hole **186** into which a shear pin **188** or spigot is inserted fixed to the turbine engine casing **150**. The hole **186** is elongated in shape along the vertical direction Z (FIG. **15a**) such that the shear pin **188** is blocked in the hole **186** along the longitudinal direction X, but is free to move along the vertical direction Z.

In this embodiment, there is no need for the central aft engine mounting **152** to participate in resisting longitudinal forces, such that it may be dedicated solely to resisting forces along the transverse direction Y. In this case, as shown in FIG. **16**, the hole **102** of this aft central engine mounting **152** may be extended along the longitudinal direction such that the corresponding shear pin **156** is blocked along the transverse direction Y but is free to move along the longitudinal direction X.

Furthermore, in this embodiment, the forward engine mounting is preferably of the same type as that shown in FIG. **14** described above, to assure that forces oriented along the vertical direction Z and also forces oriented along the transverse direction Y are resisted.

Furthermore as a variant, longitudinal forces may be resisted by two thrust rods of a known type, each with an aft end connected to the aft casing **144** of the turbine engine and a forward end connected to the distal end **26** of the mounting structure **18**.

In this case, transverse forces may be resisted by a lateral engine mounting of the same type as the engine mounting **146** described above with reference to FIGS. **7** to **12**. Furthermore, the forward upper engine mounting may then be dedicated to resist vertical forces as in the first embodiment described above, and therefore may be of the same type as the forward upper engine mounting **134** described above (FIG. **9**).

FIG. **17** shows a propulsion unit **10** according to another embodiment of the invention, in which the structural skin **30***a* and the aerodynamic upper skin **30***b* globally have the same shape as in the embodiments described above, but on the other hand they are not made in a single piece. These two skins **30***a*, **30***b* are spliced to each other in this case. The structural skin **30***a* has a proximal end portion **190** on which a first portion **192** of a fish plate **194** is fixed, for example by means of bolts or rivets of which only center lines **196** are shown in FIG. **17**. The fish plate **194** comprises a second portion **198** fixed onto a distal end **200** of the aerodynamic upper skin **30***b*, also by means of bolts or rivets with center lines **202**. The fish plate **194** preferably extends over the entire length of the rigid mounting structure **18**.

In the example in FIG. **17**, the spars **52**, **54**, **56** of the rigid mounting structure **18** are fixed to the forward arch **62**, the median half arch **74** and the aft arch **64**, either directly by means of bolts or rivets (not shown) with center lines **204**, or by means of a fish plate.

As a variant, as shown in FIG. **18**, spars **52**, **54**, **56** may be connected to the forward arch **62**, to the median half-arch **74** and to the aft arch **64** respectively, by corresponding devises **206**.

In all cases, as can be seen in FIG. **19**, the structural skin **30***a* may be prolonged downwards between each pair of successive spars of the rigid mounting structure **18**, to enable attachment of this structural skin **30***a* by fish plating onto the lower skin **116** of the mounting device **14**. For example, such splicing may be made by two fish plates **208** (only one of which can be seen in FIG. **19**), the first of which is arranged between the forward spar **52** and the median spar **54**, while the second is arranged between the median spar **54** and the aft spar **56**. In the example shown, these fish plates **208** are fixed in contact with the radially inner face of the structural skin **30***a*, but as a variant these fish plates **208** may be fixed in contact with the radially outer face of the structural skin.

The invention may obviously be transposed to other types of turbine engines, particularly to a turbojet with a pair of open rotor pushers mounted at the forward end. In this case, the arrangement of the mounting device **14** may be inverted along the longitudinal direction, the additional arch **82** then being located at the forward end.

As is apparent from the foregoing specification, the invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. It should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

The invention claimed is:

1. A propulsion unit for an aircraft, comprising:

a turbine engine with a longitudinal axis parallel to a longitudinal direction of said turbine engine, and

an engine mounting device designed to be added laterally on an aircraft structure,

said mounting device comprising a rigid mounting structure with a proximal end that will be connected to the aircraft structure and with a distal end arranged facing the turbine engine,

said rigid mounting structure supporting connecting means connecting said turbine engine to said rigid mounting structure, in which:

said connecting means comprise at least one arch with a proximal end connected to said rigid mounting structure and an opposite distal end;

said arch being concave towards said longitudinal axis;

said proximal end and distal end of said arch extend on each side of a longitudinal plane containing said longitudinal axis, said longitudinal plane extending vertically when said propulsion unit is fitted on an aircraft parked on the ground; and

when said arch is seen in a sectional view on a transverse plane orthogonal to said longitudinal axis, a first half-line and a second half-line delimit a first angular sector with an angle of between 45 degrees and 120 degrees, wherein the first half line starts from said longitudinal axis and passes through the distal end of said arch, and the second half-line starts from said longitudinal axis, is contained in said longitudinal plane, and intercepts said arch,

wherein said connecting means comprise a distal connecting element connecting the turbine engine to a distal mounting part of said arch and arranged on the same side as said distal end of said arch relative to said longitudinal plane, said distal mounting part being arranged such that when said arch is seen in a sectional view on said transverse plane, said distal mounting part extends outside a second angular sector defined such that:

the longitudinal axis is a vertex of the second angular sector,

the second angular sector forms an angle equal to between 25 degrees and 100 degrees,

the angular sector extends from said second half-line towards said distal end of said arch.

2. The propulsion unit according to claim **1**, wherein said connecting means also comprise a proximal connecting element connecting the turbine engine to a proximal mounting part of said arch, said proximal mounting part being arranged such that when said arch is seen in a sectional view on said transverse plane, said proximal mounting part extends outside a third angular sector defined such that:

the longitudinal axis is a vertex of the third angular sector,

the third angular sector forms an angle equal to between 25 degrees and 100 degrees,

the third angular sector extends from said second half-line towards said rigid mounting structure.

3. The propulsion unit according to claim **1**, wherein at least one of said distal connecting element and said proximal connecting element is a mechanical energy dissipation element arranged to damp turbine engine vibrations.

4. The propulsion unit according to claim 1, wherein:

said rigid mounting structure is in the form of a box,

said arch prolongs a spar which forms a first end of said rigid mounting structure along the longitudinal direction,

said connecting means comprise a second arch that prolongs a spar forming a second end of said rigid mounting structure, opposite said first end of said rigid mounting structure,

said second arch being concave towards said longitudinal axis of the turbine engine and having a distal end extending on the side of said longitudinal plane opposite said rigid mounting structure, and

when said second arch is seen in a sectional view on said transverse plane, a first half-line starting from said longitudinal axis and passing through the distal end of said second arch delimits a fourth angular sector with an angle between 45 degrees and 120 degrees, with a second half-line starting from said longitudinal axis, contained in said longitudinal plane, and intercepting said other arch.

5. The propulsion unit according to claim 1, wherein said connecting means comprise a longitudinal beam supported by each arch connected to said rigid mounting structure.

6. The propulsion unit according to claim 5, in which said longitudinal beam is centered relative to said longitudinal plane and supports a second additional arch offset along the longitudinal direction, from said rigid mounting structure, and centered relative to said longitudinal plane, said second arch supporting two lateral engine mountings arranged on each side of said longitudinal plane and designed to resist forces oriented along a vertical direction parallel to said longitudinal plane and orthogonal to said longitudinal direction, and a central engine mounting that is centered relative to said longitudinal plane and designed to at least resist forces oriented along a transverse direction orthogonal to said longitudinal and vertical directions.

7. The propulsion unit according to claim 6, wherein said central engine mounting supported by said second arch is also designed to resist forces oriented along the longitudinal direction.

8. The propulsion unit according to claim 6, wherein said rigid mounting structure supports an engine mounting at its distal end, designed to resist forces oriented along the longitudinal direction.

9. The propulsion unit according to claim 6, wherein said longitudinal beam supports an engine mounting arranged on the longitudinal side opposite said second arch relative to the rigid mounting structure, and designed at least to resist forces oriented along the vertical direction.

10. The propulsion unit according to claim 9, wherein said rigid mounting structure comprises an engine mounting at its distal end, designed to resist forces oriented along the transverse direction.

11. The propulsion unit according to claim 9, wherein said engine mounting, supported by said longitudinal beam and arranged on the longitudinal side opposite said second arch, is also designed to resist forces oriented along the transverse direction.

12. The propulsion unit according to claim 1, further comprising an external aerodynamic fairing, and in which:

said external aerodynamic fairing comprises a structural skin that covers and is fixed to each arch connected to said rigid mounting structure, extending at least as far as the distal end of the arch, and

said connecting means are designed such that part of the connection forces between the turbine engine and said rigid mounting structure is resisted by said structural skin of the external aerodynamic fairing.

13. An aircraft comprising at least one propulsion unit according to claim 1, wherein each arch connected to said rigid mounting structure comprises a part extending above the turbine engine of said propulsion unit when said aircraft is parked on the ground.

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